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EDITORIAL NOTES.

When Doctors Differ, then Collaborate.

THE more research work is studied, the more convinced are we that there comes a stage when, through difficulties arising, it is desirable that there should be a departure from individual investigations to one conducted on the collective advice of those who have been making similar research. In other words, there should be a co-ordination of procedure to get down to the truth of matters where there is any divergence of opinion, or where, by different processes of conducting the inquiry, findings differ or doubts exist. There are unquestionable advantages in separate research at the initial stages; but when, subsequently, views and opinions disagree, then the time has come to get together for the common good and a determinate result, rather than enter upon long controversies which, probably through jealousy of the results of one's own work, may continue *ad infinitum*.

These thoughts recur on reading the paper by Dr. A. Parker, Research Chemist to the Joint Committee of the University of Leeds and the Institution of Gas Engineers, on "A Thermal Study of the Process of Manufacture of Water Gas," which was submitted last week at a joint meeting of the Yorkshire Section and the Fuel Section of the Society of Chemical Industry, as reported in later columns, when other topics of importance to the gas industry were also under consideration. No one recognizes more than Dr. Parker how great are the difficulties encountered in experimental work of the type with which he is dealing. Present-day knowledge in this, as in some other lines of research, show how the conclusions of preceding investigators cannot be accepted with confidence, owing to failure in some respect to comprehend the entire range of fundamentals, and to fix upon methods of investigation which will be generally approved. In the study of the thermal efficiency of the water-gas process, there are losses which it is difficult to measure; and they are assumed by difference between the heat supplied and the heat expended so far as it is capable of being measured. But when that is done, we have the fact that, with different plants, different conditions of location, fuel, and methods, the heat-balance result can easily be vitiated. However, the Joint Gas Investigation Committee have done much to advance our knowledge of the thermal balance of the water-gas process; and they have provided valuable data. In the present paper, Dr. Parker quotes a thermal balance from the Tenth Report of the Research Committee; and he gives explanations regarding the heat supplied and expended. But he himself shows there are impediments to a refined accuracy, for which there has to be assumption or deduction from the reliably ascertained data relating to other items. In our columns in 1925, Dr. Travers criticized the results in certain particulars. It will be seen in the discussion upon Dr. Parker's paper in other columns this week that he is still a critic. It will also be found from the remarks of Dr. J. G. King, of the Fuel Research Station, that the research staff there have, in similar investigation, also come up against the difficulties of the unaccounted-for heat losses and the unknown losses in the blow gases.

This point as to losses in the blow gases is one which the various investigators find a very real difficulty in constructing an accurate balance-sheet for the water-gas process. Dr. Parker says that the amount of carbon in the blow gas produced was taken in his experiments as the difference between the weight in the coke supplied to the generator and the total of the weights accounted for in the other items. The Research Committee in two of their reports have pointed out that this method of calculation is not strictly accurate, since it includes a certain amount of solid carbon which is carried forward up the stack by the blow gas, and into the scrubber by the water gas. But it appeared to be the only method of calculation available; and in any case the results should be sufficiently accurate for the purpose of the tests. This shows that the investigators were fully aware of the source of error in the method adopted for determining the volume of the blow gases. There is also the loss of carbon occurring by combustion during the operations of clinkering. Dr. Parker says that the ideal would be to make correct direct measurements of the air supply to the generator; but this is not easy of achievement with the intermittent flows and changing pressures obtaining in the manufacture of water gas. They have also found that measurement by the Pitot tube is less satisfactory for this particular purpose than the method adopted, and so the idea was rejected. In the experiments at the Fuel Research Station, the volume of blow gases has been measured by Pitot tubes, as well as calculated. But the results have not been published, because the investigators were not satisfied with them, which confirms the view of Dr. Parker. The only other method Dr. King can see is to use a holder; but this has not yet been attempted. From the Fuel Research Station trials in measuring the carbon loss at blow periods, the amount escaping at the stack during clinkering, the amount taken out in the clinker, and that carried forward as dust in the water gas, it was found that the losses were less than 1 p.ct. of the total carbon added to the generator. Then Dr. Travers is of opinion that since, in the results quoted by Dr. Parker from the report of the Gas Investigation Committee, the potential heat and the sensible heat of the blow gas were calculated from the difference item of a carbon balance, a balance should be obtained without the inclusion of the various losses not separately determined—viz., leakages, radiation, convection, &c. Further, in a recent publication, Dr. Travers has expressed the opinion that, in studying the results of tests of water-gas plant, separate thermal accounts for the blow and run processes form a useful criterion of the accuracy of the tests. With this Dr. Parker agrees, provided the whole of the fundamental data used in the construction of the separate accounts are known to a sufficient degree of accuracy.

Throughout the paper and the discussion, difficulties are found arising, from uncertainties existing in connection with the basic data, in constructing a true thermal balance for the water-gas process. We have cited the foregoing points with the view of emphasizing those difficulties. If surmounted, there would still be the difficulty of measuring the radiation and other losses. Hence, there will be an inclination to agree with Dr. Parker that, until more definite fundamental data are arrived at, thermal accounts for the water-gas process, such as the one given in his paper, represent the most practical method of making a useful analysis, which means, for the time being, the acceptance of dependence upon the determined calorific

value of coke, and not on the assumed thermal value of coke carbon, in which connection Dr. Travers points out "regretfully that the higher the temperature at which gas-works coke is produced, the lower—and materially so—is the calorific value of the carbon contained in it." It seems to us that the case is complete and knowledge ripe for the investigators in this subject to take counsel together with the object of endeavouring to determine the means of realizing a closer accuracy for a water-gas thermal balance. It would be a pity to leave the matter where it is, having advanced so far. Open discussion is all right up to a point. But for matters of a special character, it is not so good as collaboration, if it can be effected, and promises to be beneficial.

Assisted Gas Efficiency and Assisted Wiring.

The electricity supply industry is making headway with assisted wiring; and some notable examples of what has been done have come from Newcastle-upon-Tyne, South Shields, and other places. The propagandists in that industry are seriously pushing this system of securing new business, because they believe in its efficacy; and they point to illustrations of success which will have a seductive influence in other quarters. It is realized that it is the only means of connecting-up to their mains an order of consumers who cannot afford to pay cash down for wiring and equipment installation. For most part these assisted wiring schemes are confined to lighting; in some places, the electricity suppliers have already gone beyond that, and have induced some of the "assisted" consumers to launch out into electric cooking, and perhaps, to a small extent, into heating. The undertakings want the revenue from the heaviest priced units; they also desire the day load. That is the real objective. The method having taken root is sure to spread; and, wherever started, a certain amount of success will follow.

The subject has been under discussion at one of the Electrical Development Association conferences, at which a paper was read by Mr. W. F. J. Pinkney, of the Newcastle-upon-Tyne Electric Supply Company. From his experience, he is fully persuaded that the success with assisted wiring cannot fail to develop into other lines of domestic business. The policy is to get into a house, and once there to make good use of the new relations. Assisted wiring, of course, simply means hire-purchase. There are a variety of schemes in existence, ranging from short-period ones (say, two or three years) up to long-period ones (say, ten years) during which the wiring is paid for in the shape of an agreed rental. The lighting points comprised in the installation vary according to the desires of the consumers. In the case of the Newcastle-upon-Tyne Company, the wiring work is carried out to a specification; and the Company maintain the installation for a year, and thereafter small repairs are carried out free of charge. The Company in 1926 added 16,472 new consumers to their register, of which 10,071 were taken on under the assisted wiring scheme. Now it is in contemplation tc offer assisted wiring to any consumers for cookers and electric fires. Of the 10,071 consumers, 2689 pay their rentals monthly; and 7382 through prepayment meters by the addition of the cost to the unit charge. The average net cost of the wiring installation for the monthly paying consumers was £9 6s. 4d.; and for the prepayment ones, £5 9s. 2d. —an average on the total of £6 9s. 8d. The sum paid to the installation contractors was £65,345. For both classes of consumer £1 10s. was provided for in rentals as the service contribution. The year's revenue for energy supplied to the consumers on the monthly system was £11,500; and from the prepayment ones, £23,600—together £35,100. The average consumption per annum by the former was 165 units; and by the latter (estimated), 110. It will be understood that all these figures refer solely to 1926.

We have quoted the data, as given by Mr. Pinkney, for Newcastle, to show that assisted wiring for electricity is not a negligible quantity for the gas industry. It is clear that it affords an inlet for our competitors to a new class of consumer. This is being done while many gas undertakings shy at, or avoid, inspection and maintenance, which means assisting the consumer to obtain higher efficiency, and thus more economy, from his gas installation. Our competitors are not debarred, by any question of responsibility or liability, from making use of every possible expedient for getting into dwelling-houses and other premises. Though the gas undertaking in every town is already giving a supply, the majority of them refuse to show themselves beyond the meter, or to take the slightest interest in the conditions which exist in the house, and which conditions may, through ignorance of the intrinsic merits of gas, be of a character which will make assisted wiring more welcome than it would be otherwise. The barricade of gas efficiency and economy is no mean one if properly established and maintained. Ingenuity is far from being dead in the gas industry; but adoption is a slow growth, even in the face of proved advantages—such as those which progressive undertakings have found from experience. The assisted wiring figures from Newcastle must not be taken as casting any reflection upon the Gas Company. Newcastle is a large city, in which an innovation of any kind will produce figures which may appear imposing to gas men operating in small places and in different circumstances; but, relatively, they are not. And with such gas activity as exists at Newcastle, we can imagine that, if saturation point is not reached early by assisted wiring, the effects of the work of the Gas Company will soon cause a slowing-down of the rate of the additions to assisted electrical installations. Where these succeed in getting in for lighting purposes, there is good ground for seeing that gas cooking and heating appliances are maintained in first-class order, and for endeavouring to promote new applications from which compensating business will be derived. The policy of inspection and maintenance in our opinion is the best possible opponent of assisted electric wiring, and for increasing consumption where it is successful. Our methods of resistance to competition and of developing business must be superior to those of the competitor. We already have a front place in respect of value for money; but that front place has very definite relation to the condition of the appliances by which gas is used. In other words, the distance of superiority over the competitor recedes from the maximum as neglect of the appliances causes their efficiency to decline. No one will be prepared to contest the truth of that, and yet responsibility to the interests of the gas undertaking is sacrificed to indifference, or to the apparition of liability.

First Contracting-Out Scheme.

Perseverance has at length rewarded the South Metropolitan Gas Company and their employees. They have always favoured being totally free to manage their own affairs in respect of provisions for sickness, unemployment, and superannuation, which run back to 1842 in the case of sick benefits by mutual contributions, and to 1855 for superannuation. As Dr. Carpenter told the proprietors at their recent annual meeting, when the State, in 1911, imposed its scheme of compulsory health insurance, the co-partners of the Company pleaded hard to be allowed to contract-out of its provisions in a manner similar to that obtaining with regard to accident insurance. But they were disappointed over the result of their desire, although they were allowed to reconstitute their sick fund to suit the requirements of the Insurance Commissioners. Then in 1920, when State insurance against unemployment was established, efforts were again made by them to contract-out, but were futile, though by an arrangement with the Ministry of Labour, they were enabled to provide unemployment benefits in substitution for those otherwise payable to the Employment Exchanges. Then in 1921, the employees' superannuation fund was revised and remodelled to suit the altered conditions as regards wage values; and thus, as Dr. Carpenter says, private enterprise, not for the first time, proved to be in advance of the State. Three years later, the State scheme of insurance was extended to provide old-age pensions at 65, and included widows and orphans.

Following upon this, conference between the employees and representatives of the Company's administration resulted in a decision to make another effort to raise the question of contracting-out, and of merging the existing

funds for sickness, employment, and superannuation into one. A mutually "all-in" insurance scheme was fashioned and agreed to; and this constitutes the first contracting-out scheme to be approved by the Minister of Health under the Act of 1925. We congratulate the Company on the success of their perseverance. In designing this "all-in" scheme, the principal difficulty was to graft on to the existing benefit funds of the Company the payments prescribed by the State insurance schemes; but this difficulty was eventually negotiated, and the goal attained. The advantages of the "all-in" scheme and contracting-out were summed up by Dr. Carpenter with the words that "the benefits would be greater, and the cost less;" at the same time adequate provision has been made for those who leave the Company's service automatically to take up the State benefits and make State contributions. Thus, the Company will administer their own funds on a true co-partnership principle; and, in the opinion of the President, there is great prospect of a successful future for the new constitution. The "all-in" scheme will be also of far-reaching importance, and not least as an endeavour to formulate means whereby individual effort may act as a substitute for official control.

It will, of course, be remembered that only statutory companies are eligible for contracting-out of the State insurance schemes. To do this they have to put forward a scheme which will ensure to their workers benefits which are, on the whole, no less favourable than those under the Insurance and Pensions Acts. When the Minister of Health has certified the benefit provisions, they become part of the terms of employment of the undertaking to which the employees must submit, and look for the benefits to which they are entitled. There can be no question that, under such an arrangement as that developed by the South Metropolitan Company, the bonds between the Company and employees are materially strengthened to mutual advantage.

Co-operative Coal Selling—No Compulsion.

DURING the life of the present Government, there will be no compulsory co-operative selling of coal in this country. In the report of the *ad hoc* Committee who recently considered the matter, voluntary co-operative selling schemes are favoured, with compulsion only in cases where the major part of the industry in a district is desirous of giving effect to such a scheme. It is curious that both the Royal Commission of 1925-26 and the Sankey Committee of 1919 were favourable to co-operative selling; but there is good ground for doubting whether, if their inclination was towards its being made compulsory, they had considered all the *pros* and *cons* of the matter. In the House of Commons recently, a motion was proposed from the Labour side by Mr. Parkinson to the effect that it would be in the interests of the coal-mining industry and of coal consumers if the Mines Department promoted a scheme of co-operative agencies for the selling of coal. What the mover professed to have in view was the suppression of all coal factors—a condition which would not be very acceptable to those so engaged—and the setting-up of an organization which could deal with everything between the pits and the consumers. This would lead to undesirable complication, and would wipe-out entirely that excellent and active factor—competition as between district and district. We rather fancy, too, this interest of the Labour Party in co-operative coal-selling agencies (which would place the industry under protection, a term which is extremely provocative to the Labour Party when suggested in relation to foreign goods) is only another implement they would like to have forged for assisting them in their policy of nationalization.

Another aspect of the matter was presented by Mr. Varley, who in the House is one of the representatives of the miners. Seconding Mr. Parkinson's motion, he frankly confessed that his object was to see selling organizations constituted for the purpose of bringing more money into the coal industry—palpably for the benefit of the miners. In other words, he wished to institute a fictitious state of things to oppose economic conditions for the benefit of a relatively small section of the community. To do this would mean that the consumer would have to pay more. While Mr. Parkinson complained bitterly of the high prices that are charged for coal under the existing system of dealing with it, Mr. Varley would have the selling organization commanding prices which would produce a greater revenue per ton. The logical result of what he desires would be to make the industries pay more for fuel, which should be cheaper to enable them better to compete with foreign manufacturers, and so create and maintain more employment than exists at the present time. We are rather surprised that the Labour leaders connected with other industries did not protest against the attitude of Mr. Varley, seeing that the alleged object of the mover of the resolution was to secure, through co-operative agencies, a reduction of the price of coal. As a matter of fact, miners' pay is not, in ordinary circumstances to-day, at all bad compared with that of the industrial constituents of many of the other members of the Labour Party; and the protection of the employment of those constituents should be a first consideration when considering doing anything which would raise the cost of fuel. Then, again, a large proportion of domestic consumers of coal, coke, or gas are engaged in industrial or commercial occupations; and Mr. Varley would like them to pay higher prices in order to get still more money for the miners.

However, nothing came of the motion, in view of the fact that the Government are convinced that selling organizations must not be forced upon industry. There can be no restraint of trade in this manner. The attitude of the Government was clearly expressed by the President of the Board of Trade (Sir P. Cunliffe-Lister) when he said it is not the business of the House of Commons to coerce an unwilling industry into the conduct of its business in a particular way. He also definitely said that the Government had given very careful attention to the report of the Commitee on this subject; and they were not inclined to take any compulsory action in the matter. Their view is that it would be impossible to limit any such action to the coal industry. Naturally, if it is right to insist on compulsory co-operative selling in the coal industry, the principle would have to be applied to other industries. No Government would take such a step, as by doing so they would become directly responsible for the success of the industry, and for the whole conduct of those engaged in it. Thus it may be concluded that compulsory co-operative selling of coal in this country is dead; and it can only come about by voluntary action within the industry itself, unless a revolutionary Labour Government again secures office.

New Houses and Gas Connections.

Speaking at the recent meeting of the Tottenham District Light, Heat, and Power Company, the Chairman (Mr. Henry Woodall, M.Inst.C.E.) gave some interesting figures regarding the supply of gas to new houses in the district. He pointed out that they were all served with gas in one form or another. Of the new houses occupied in 1926, 48 p.ct. took gas for lighting, and 97 p.ct. had gas-cookers. Thus it is seen that nearly one-half the new houses use gas for lighting, while practically all of them employ gas for cooking—this apart from consumption for room heating.

An Early Advocate of Maintenance.

We should imagine that Mr. F. S. Cripps was one of the earliest writers in our columns on the subject of the maintenance of consumers' appliances. In our issue for Sept. 11, 1894, a letter appeared from him, in the course of which these passages occurred: "Something is needed to stir up the gas people to take more interest in the gas after it passes the consumers' meters. If the various gas engineers' institutions would but devote a portion of their energies (by appointing special committees or otherwise) to the encouragement of artistic design in gas-fittings, and to the proper presentation of gas to the consumers, it could not fail to be beneficial. As things are now, they practically concentrate their attention on gas as far as the meters, after which it is left to take care of itself. Unfortunately, it is only where the gas supplier parts company with the gas that the consumer begins to take an interest in it. The general public judge entirely of gas after it passes their meters; and it is what takes place after the

meters that the gas fraternity ignore, although it is by the after-treatment alone it stands or falls in the estimation of the public." Those truths might have been written yesterday instead of 32 years or more ago.

Coal Output.

The coal output at the British mines is being maintained at an excellent level. For the week ending Feb. 5, the quantity raised was 5,267,000 tons; Feb. 12, 5,360,900; tons; Feb. 19, 5,365,900 tons. The wage earners during the three weeks were: Feb. 5, 1,000,600; Feb. 12, 1,006,200; Feb. 19, 1,010,500.

Nine Months' Coal Statistics.

In the "Board of Trade Journal" some interesting figures are given regarding the coal-mining industry during the last nine months of 1926. The statistics, of course, include April; and then the seven months' coal stoppage, during part of which a number of collieries in Nottinghamshire and other areas were working. The returns show that the output of saleable coal during the three quarters of the year was 58,781,000 tons, of which 17,656,000 tons were mined during the strike period from May to November. The statistics are exclusive of coal obtained from shallow outcrop workings, the quantity of which is estimated to have exceeded 100,000 tons a week for the period when supplies were shortest. It is estimated by the Board that—including output, imported, outcrop, and pit-heap supplies, and allowing for stocks in consumers' hands—from 80 to 85 million tons were available for consumption during the nine months; and for the whole year, 128 to 133 million tons, which compares with an annual average consumption of 169 million tons in the years 1922 to 1925. It is pointed out as being remarkable that the fuel consumption of the country last year declined by no more than 25 p.ct.

Rival Movements.

The Communists are making an effort to form in the mining areas a single union with "a revolutionary outlook." This, it seems, would be a revised, but worse, edition of the Miners' Federation; and the organization would work, among other things, for a national agreement, a seven-hour day, and nationalization. This would be practically the programme which protracted the stoppage last year into a seven months' one; and the majority of the miners are not amicably inclined to be parties to any more of the political intrigue and folly which landed them in such dire straits as they experienced last year. The Communist Party—after the manner of true Bolshevists—urge the miners, while the employers are concentrating on the recovery of lost markets, to make matters more difficult for them by having local and district stoppages on questions of local custom and the violation of agreements. But from what is gathered, the miners have no present intention of being fooled again by those rabid gentry. The miners' non-political unions are daily gathering strength. There are now sixty branches of the South Wales Industrial Union; and satisfactory progress is reported from Nottinghamshire and Durham. The miners have been working well since their return; and for most part they show they have had enough of being the tools of political adventurers.

Trade Union Law.

The Prime Minister announced last Wednesday that the text of the Bill to amend trade union law would be circulated before Easter; but the second reading debate would not take place until after the recess.

Unemployment.

Week by week now the number of unemployed on the registers of the Labour Exchanges is being reduced. The figure on Feb. 21 had descended to 1,196,100. Compared with only seven days before, 74,117 had returned to work, which made the total of unemployed (as given above) only 70,340 more than in the corresponding week of last year.

PERSONAL.

Among recently elected members of the Society of Chemical Industry are Mr. John Wilkinson, Engineer to the Nottingham Corporation Gas Department, and Mr. John A. McConnell, Assistant Chemist at the Belfast Corporation Gas-Works.

OBITUARY.

HARRY KENDRICK.

There were many expressions of regret among his old friends at last Friday's meeting of the Manchester District Institution of Gas Engineers at the death of Mr. Harry Kendrick, who passed peacefully away on Tuesday, March 1. Mr. Kendrick, who was in his 63rd year, was always active in furthering the interests of the industry to which he belonged. For 27 years he was connected with the Stretford gas undertaking (which at one time belonged to a Company, but was afterwards taken over by the Stretford and District Gas Board); retiring from the position of Engineer and Manager at the end of 1922. In 1910 he was President of the Manchester Institution, of which body for five years up to 1908 he acted as Hon. Secretary. Suitable acknowledgment of the excellent work which he performed in the latter capacity was made on his retirement by the members, who presented him with a gold watch, a diamond ring being at the same time given to Mrs. Kendrick. His other activities on behalf of the profession, to the furthering of the welfare of which he devoted so much energy, included the Examinership in Gas Supply for the City and Guilds of London Examinations.

To the widow and family deep sympathy in their bereavement is extended.

It is with great regret that we learn of the death of Mrs. Meiklejohn, widow of the late Mr. John Meiklejohn (formerly Manager of the Yorktown and Blackwater Gas Company), and mother of Mr. Robert J. Meiklejohn, the Engineer and Manager of the Rugby Gas Company.

FORTHCOMING ENGAGEMENTS.

March 11.—Institution of Chemical Engineers.—Fifth annual meeting and annual dinner at the Hotel Victoria, Northumberland Avenue, W.C. 2.

March 12.—Scottish Junior Gas Association (Western District).—Meeting at the Royal Technical College, Glasgow. Paper by Mr. Robert Fife, of Kilmarnock, on "Metals Used in Gas-Works Practice."

March 16.—Yorkshire Junior Gas Association.—Joint meeting with the Manchester and District Junior Gas Association. Visit to the works of the Elland Gas Company and to Messrs. R. Dempster & Son.

March 16.—British Commercial Gas Association.—Midlands District Conference at Smethwick.

March 16.—National Benzole Association.—Annual general meeting, 4 p.m. The chair will be taken by Sir David Milne-Watson.

March 17.—Midland Junior Gas Association.—Meeting in Birmingham. Paper by Mr. A. St. D. Corder.

March 17.—Murdoch Lodge, No. 3480.—Installation meeting.

March 19.—Manchester and District Junior Gas Association.—Visit to the Blackburn Gas-Works and Showrooms.

March 23.—Evening Star Lodge.—Installation meeting.

March 24.—Midland Association of Gas Engineers and Managers.—Visit to the Stanton Ironworks.

March 25.—London and Southern District Junior Gas Association.—Meeting at the Westminster Technical Institute. Short papers by Mr. J. H. Goldsmith and Mr. S. H. Miles.

March 26.—Scottish Junior Gas Association (Eastern District).—Visit to the Dundee Gas-Works.

March 26.—Scottish Junior Gas Association (Western District).—Visit to the Tradeston Gas-Works, Glasgow.

March 30.—Southern Association of Gas Engineers and Managers.—Annual general meeting at the Hotel Cecil, Strand, W.C. 2, at 2.15.

April 1.—British Commercial Gas Association.—North Wales, Cheshire, and Lancashire District Conference at Wallasey.

April 2.—Manchester and District Junior Gas Association.—Annual meeting and dinner at Parker's Restaurant, Manchester. Paper by Mr. A. McCulloch on "The Coking of Coal."

April 8.—North British Association of Gas Managers.—Annual spring meeting at Dumbarton.

April 12.—Federation of Gas Employers.—Meeting.

April 12.—National Gas Council.—Meeting.

May 5.—Eastern Counties Gas Managers' Association.—Spring meeting at Ipswich.

May 5.—North of England Gas Managers' Association.—Annual meeting at Newcastle.

May 20.—British Commercial Gas Association.—Manchester District Conference at Buxton.

May 26.—Midland Association of Gas Engineers and Managers.—Spring meeting at Dudley.

May 26.—Society of British Gas Industries.—Annual general meeting and dinner, at the Hotel Cecil.

Institution of Gas Engineers.

June 14-17.—Annual General Meeting in London.

ELECTRICITY SUPPLY MEMORANDA.

The Chairman of the new Central Electricity Board (Sir Andrew Rae Duncan) formally took up his duties on the 1st inst.; and on Thursday a meeting of the Board was held, at which preliminaries were discussed.

To Prevent Supposed "Robbery."

It is stated that schemes relating to Scotland and the East Midlands are already available for the consideration of the Board. In connection with the advent of the control of electricity generation, a somewhat fatuous idea has had birth at Cardiff. At a meeting of the Corporation Finance Committee, the question has been discussed as to whether the balances standing to the credit of the Electricity Department, amounting to about £115,000, should be applied in aid of the rates before the Electricity Department are placed under the control of the Central Board on April 1, or whether the Corporation should allow the balances to remain on loan at interest with the Department, on the understanding that they must after April 1 build-up new credit balances. Of course, the undertaking as a whole is not passing under the control of the Central Board; the Board only dealing with generation and transmission. We see nothing in the new Electricity Act which will enable the Board to interfere with, or appropriate, any accumulation of money the Department have made in the past. Their functions end with the provision of electricity, and do not enter into trading with the community, though it is true the Act provides for any economies that may be effected going to the consumers, and for the participation of the ratepayers (fifth schedule of the Act) in profits to the extent (if at all) of only 1½ p.ct. on the outstanding debt of the undertaking. The Chairman of the Cardiff Corporation Finance Committee (Alderman F. H. Turnbull) thinks the whole of the balances should forthwith be taken in aid of the rates. He also regards the new position as State ownership and rank socialism. Alderman W. B. Francis is of opinion they should take the opportunity of preventing the "robbery" of £115,000 from the Cardiff ratepayers. These gentlemen have, of course, found a mare's nest; and no doubt the Electricity Committee will politely so inform them, and will prefer that the reserves be allowed to stay in their own keeping for the use and protection of the undertaking. No one quite knows what is now going to happen. The Finance Committee and the Electricity Committee have been conferring. What the outcome has been, we have not yet seen; but we can guess its nature.

A Fight for Protection.

There is a mistaken impression in the electricity industry that the claim of gas undertakings to protective clauses in Special Electricity Orders or Private Bills—such clauses as the Northumberland, Winchester, or other variants—is due to their fear of competition. It is not, unless looked at from the standpoint that private enterprise is entitled to object to rate-aided competition by municipal undertakings. Their real objection, however, is as large ratepayers. They hold that municipal undertakings ought to be run with commercial and financial rectitude, and not in a manner which demands financial support from the ratepayers, many of whom have no desire for electricity, and have equally no wish to pay for the support of the service to others. It is rather a Gilbertian situation to fine people through the rates for not buying something they do not require; and the description also applies to calling upon a gas undertaking to contribute to the maintenance of an undertaking which is in direct competition with it, and doing its best to wrest from it business, and so make it poorer. If local authorities are composed of business men, they should have no difficulty in placing themselves in the position of the gas undertaking, and considering how they would regard rate-aided competition, and being compelled to support the competitor financially. They would be the first, as business men, to say that the electricity concern must be run on strictly commercial lines.

The Case of Bridport.

There is the case at Bridport; and the facts have been presented at an inquiry held by Colonel Ekin on behalf of the Electricity Commissioners. The Council are desirous of obtaining an Order to enable them to generate and distribute electricity in the town and rural districts of Bridport and Beaminster. The Gas Company opposed not on the ground of competition, but as ratepayers. All they ask for is the insertion of the Chichester clause. A stronger case for this clause being granted we cannot conceive; and we shall be surprised if, after the exposure of the weaknesses of the scheme, the Commissioners do not grant the clause without demur, or refuse to accept the Order. Mr. A. Hugh Seabrook, who gave evidence in support of the Gas Company's application, played havoc with the estimates of commitments and business prospects; and, while this was going on, as well as during the cross-examination of the Council's witnesses by Mr. J. Roper, the feelings of those who appeared in support of the project and the estimates cannot have been of the happiest order. The scheme is one which has been propounded by Mr. T. Hood; and it has been adopted by the Council, who, however deserving of the title of business men, are obviously not electrical experts. The author of the scheme visualizes a net profit from the first year's working of £265. He arrives at this by assuming that 448,000 units of electricity will be sold at an average price of 1¼d., and that 42,000 units will be disposed of at 8d., giving (with £50 from meter-rents) an income of £4100. This optimistic computation does not appear to have any substantial foundation. It seems from the evidence that the 42,000 units include 12,000 for street lighting, or 5000 for the first year. Mr. Seabrook also finds it is calculated that the average consumption per house will be 450 units, or per head of the population 82 units, in the first year. Good electrician as Mr. Seabrook is, we can imagine his lifting his eyebrows in astonishment over this assumed prompt and generous patronage by Bridportians of their electricity undertaking. A consumption of 450 units per house at 8d. means £15 a year! and the Council are asking for the right to a maximum price of 1s. On the income side of the account, the prospects of realization are very critical. But if the report before us is accurate, and the forecast is weak, what is to be said of the outgoings? These are constituted of wages, £1530; fuel and general charges, £1305; and interest on loan (assumed), £1000—making £3835. The £1000 for interest would allow of a capital expenditure at 5 p.ct. of only £20,000; and in the figures we detect nothing for sinking fund or depreciation. Even if generation could be accomplished at Bridport for 3 lbs. of fuel per KW.-H., 656 tons of coal would be required for the 490,000 KW.-H. which, it is assumed, would be sold the first year. Therefore, £1305 is very modest for fuel and "general charges." The scheme and its promises are altogether most nebulous; and if the Electricity Commissioners send the Order forward for confirmation, justice demands the insertion of a protective clause. We are sorry to see the Town Clerk (Mr. Austen Whetham) submitting to the Inspector such an illogical argument, as, if such a restriction were imposed, it would be possible for the competitors of the Council to lower their price so as to cut them out, even though they [the gas competitors] made a loss. That would be very foolish on the part of the Gas Company, who have no rates upon which to fall back if a loss be made. The Council could lower their price in the attempt to "cut-out" the Gas Company, and compensate the undertaking from the rates for any loss it made. Again, if the Gas Company make a loss, it is only those financially interested in the concern who suffer, and not the ratepayers generally. To leave out the clause, is to give protection to unsound business methods; to insert the clause is to compel the application of sound commercial principles.

Big Expenditure.

We remember that the Weir Report prophesied that the development of electricity within the next few years would require the expenditure of at least £250,000,000 of new capital. Sir Duncan Watson, one of the members of the new Electricity Board, at a recent luncheon in London, also stated his belief that a modest computation of the money to be expended in the next fifteen years, in the development of the supply side of the industry alone, would be £250,000,000; and this takes no account of the money to be spent on the other side, by which we take it he means generation. Turning to another source of information regarding big expenditure, some details of the technical scheme of the West Midlands Electricity Authority has been furnished by Mr. S. T. Allen, the Chief Engineer and Manager. He states that the scheme will involve an expenditure of £3,500,000, which will be made up as follows: Purchase of generating stations (including the Birchills extension), £1,500,000; transmission mains, £400,000; sub-station switchgear, &c., £300,000; Ironbridge generating station (first section), £1,250,000; Oker Hill extension, £150,000. There is no question that with the construction of such large stations and transmission systems as are contemplated, the electricity industry is committed to a very big expenditure without confidence that the money will be promptly reproductive.

A Company not Indictable for Murder.

The case in which Messrs. Cory Bros., Ltd., and certain officials, were charged with having caused the death of Brynmoor Edward John by charging a wire fence with electricity for the protection of coal bunkers was heard at the Glamorgan Assizes last week. The case opened by Mr. Norman Birkett, K.C. (who led for the defence, in place of the late Sir Marshall Hall) challenging the indictment against the Company. The Secretary had, under protest, been appointed, when the case was before the Lower Court, as the Company's representative. Now Mr. Birkett asked whether it could be contended that the corporation was liable to be indicted for murder. There was only one judgment for murder,

and that was death, which could not be passed on a corporation. By Mr. Artemus Jones it was submitted, on behalf of the Crown, that manslaughter could be punishable by fine. While a corporation was an entity in the eyes of the law, it did not in fact actually exist; and it could only act through agents. The objection by Mr. Birkett was upheld by Mr. Justice Finlay. His Lordship said he was bound by authorities, which showed clearly that, in point of law, an indictment could not be sustained against a corporation either for felony or for misdemeanour as defined in the second count of the indictment. The indictment against the Company would be quashed. But this did not apply to the engineers concerned —Thomas Hardie, a shift engineer; T. Davies, power station engineer; and Robert Illingworth, electrical engineer. The evidence against them was much the same as when the case was before the magistrates at Bridgend (see "Journal," Jan. 26, p. 189). A verdict of "not guilty" was returned; and the defendants were discharged.

IDEAL HOME EXHIBITION.

Gas a Good Feature at Olympia.

The big crowds of people who are flocking to Olympia daily —and will continue to do so until March 26—have provided for them in the eleventh "Daily Mail" Ideal Home Exhibition an even larger and more varied display than in previous years, and one that is full of interest. The Court of Furniture, and the blaze of colour in the gardens laid out in the annexe, must be admired by all; while another section to which the word "ideal" can be applied with equal justice is to be found in the New Hall Extension.

"Village of New Ideas."

This has been named the "Village of New Ideas," and consists in the main of eight full-sized, furnished houses, grouped about a garden-fringed stream. The houses, which are all open for inspection, range from a large Tudor mansion to a £195 bungalow; and they include the two "Daily Mail" prize houses in the Architects Competition. In each house there are lessons to be learned which will be taken to heart by all to whom home means more than merely a roof to cover the head. With the exception of foundations and drainage, the building in every case is complete; and all are fully furnished. These houses, equipped as they are, form a never-ending attraction; and two of them possess special interest from the point of view of the "Journal." Of these two houses, more anon. Attention must, in the first place, be given to the joint exhibit of the London Gas Companies. Passing through the exhibition, the visitor will find that the Labour Saving Section and the Heating, Lighting, and Decoration Sections exercise their usual great attraction. As a matter of fact, there are on the present occasion more than 400 exhibitors altogether; and it may be said with truth that they have put forth the greatest possible efforts to present their ideas and wares with novelty and interest. The whole endeavour is, indeed, a gigantic object-lesson in how to manage the household on the most efficient, labour saving, and economical lines.

The London Gas Exhibit.

On this as on previous occasions the manifold domestic uses of gas are excellently exemplified in the joint exhibit of the seven principal London and District Gas Companies—namely, the Gas Light and Coke Company, the South Metropolitan Gas Company, the Commercial Gas Company, the South Suburban Gas Company, the Tottenham District Light, Heat, and Power Company, the Wandsworth, Wimbledon, and Epsom District Gas Company, and the Croydon Gas Company—the arrangements for which were left in the hands of a Committee, under the Chairmanship of Mr. F. W. Goodenough.

The exhibit occupies the same position as heretofore—that is to say, it is in the main hall, just at the foot of the big staircase leading to the gallery—but this year it is in an entirely new form, a complete showroom in miniature having been designed by Mr. Walter Tapper, A.R.A., F.R.I.B.A. Here in the six rooms provided are to be found samples of the best gas appliances for lighting, heating, and cooking in both large and small homes; and they look exceedingly well amid the restful grey colour scheme that has been employed.

Taking the general lighting first, it may be said that on the outside of the stand there are fourteen "Flambeau" brackets in bronze finish, with three-light superheated burners, vitreosil mantle protectors, and flame coloured silk shades. The effect is a striking one; and the attention of passers-by is inevitably drawn to the stand. Inside there are ten Sugg six-light ventilating lamps (on distance control) in antique silver, with bowl pattern silk shades. Supplementary lighting is furnished by handsome wall brackets, provided with Gas Light, Sugg, and "Nico" burners—all switch controlled. There are also four Evered standard lamps, and one Evered table lamp, all with "Exeter" burners, vitreosil cylinders, and silk shades.

Of gas fires, there is fitted in three of the rooms, with appropriate surrounds, and all with concealed connections, a wide range as to size, pattern, and finish. Here are the Parkinson "Conrad;" Davis "Medusa," "Canopus," and "Carolean;" Wilsons & Mathiesons' "York;" Main "Miranda" and "Cinderella;" Wright "Raphael;" Richmond "Marlborough;" and Cannon "Holbeach." In connection with the heating section of the exhibit, a special feature is a room devoted entirely to the "built-in" type of gas fires, suitable for housing schemes, and provided with economy flues. There are Davis, Main, and Parkinson fires, all hinged so that they can be swung out to show the flue arrangement at the back. The gas fire flues illustrated (the advantages of which as space savers and money savers are well known) are of three types —the "Nautilus," the brick, and the "Novocrete."

A room is set aside entirely for cookers; and here—in separate recesses, with the idea that each one can be seen and examined independently of the others—have been arranged stoves of the following types: National Gas Council "Standard," Sugg "Chef," Cannon "Challenge," Richmond "Bungalow," Main "Maintenance," Parkinson "Suburbia," Radiation "New World Junior" and "New World Elevated," and Fletcher "Aldwych." There is also a model kitchen which calls for special mention. In the recess which at one time was the home of the coal range, is a Wright "New Eureka" cooker, side by side with a "Kokette" coke boiler, for the lighting of which a gas poker with flexible tubing has been provided. The recess is illuminated by a swing-out burner, which must prove of great assistance to the cook—provided as it is with a reflector which throws the light on to the hotplate. A gas clothes airer has been installed on the right-hand side of the chimney breast; while on the left-hand side is a Potterton gas boiler, with rectangular storage tank, working on thermostatic control. The "Electrolux" gas-operated refrigerator is shown as a working unit, and proves of considerable interest; and a Cannon "Corna" gas copper, a Davis "Crystal" iron, and a Keith iron complete the equipment.

The sixth room is the ideal bathroom. In a recess at the foot of the handsome bath is a Ewart "Lightning" geyser in bronze finish; while the bath supply is also connected up to the Potterton set and the coke boiler—thus demonstrating three different methods of providing hot water, according to the season of the year. There is also a Ewart "Brilliant" geyser, with automatic valve, fitted over the lavatory basin. Useful sundries are a Ewart "Euston" towel rail and a Clark curling iron heater. A space at the back of the stand is devoted to a display of different types of coke boilers.

The lay-out is tasteful, and without any suggestion of overcrowding. Nowhere is there anything which cannot be minutely inspected, and which will not gain from such inspection.

An All-Gas House.

Now let us turn for a few minutes to the two houses in the "Village of New Ideas," which it has already been mentioned are of particular interest from a gas point of view. The prize-winning house in Class "B" of the Daily Mail" Architects Competition (an £850 house) is a pleasing little residence, designed by Mr. T. Schaerer, L.R.I.B.A., and built by the A.M.A. Portable and Permanent Building Works, Ltd.; and, from the point of view of running costs, the specimen shown at Olympia is rendered additionally desirable by the fact that it has been equipped by the South Metropolitan Gas Company with a complete "Metro" gas service for lighting, heating, cooking, and hot water supply. What this equipment means has on various occasions been detailed in our pages in connection with former exhibitions. Now, it shall merely be said that it is complete in every respect, and designed to give the utmost satisfaction to the user, whether judged from the artistic, the practical, or the economic point of view. No one can fail to be impressed by the really artistic blend of the lighting and decorations. There is nowhere any jarring note; the fittings installed being designed to suit the period of decoration employed for the various rooms. Particularly will visitors notice a three-light oxidized silver pendant of Adam design, equipped with "Metro" burners, and switch controlled—as, indeed, are all the lighting appliances in this house. In the living room a tasteful fireplace contains a "Metro-Log" gas fire, controlled by a standard tap; the supply to the fire being buried in the hearth.

In the all-gas kitchen there is installed a Potterton combination gas boiler and coke unit, to supply hot water to the bath, sink, and lavatory basin, with the addition of a linen coil for airing purposes and a towel rail as part of the bathroom equipment. This combination of gas and coke for water heating purposes is to be welcomed as bringing another product of the gas-works into the home. The coke boiler makes the kitchen warm in winter, as well as destroying household re-

fuse and supplying hot water; while the gas boiler, with the aid of the gas cooker, means a cool kitchen in summer, without depriving the household of a plentiful supply of hot water. The interested visitor who inspects dwelling after dwelling in the "Village of New Ideas," must surely be impressed by the fact that every gas exhibit in this house is installed under working conditions, and is functioning just as it would in the home of a prospective buyer.

In one of the houses—that of the County Service Association, Ltd.—there is a cooker and a gas fire by Messrs. Arden Hill & Co.

Beautiful Gas Lighting.

Resuming his walk through the village, the visitor arrives at the house erected by the Potters Bar Estate—which is described as "a sun-trap house in the Tudor style." Here, again, the enterprise of the South Metropolitan Gas Company is in evidence, for the house is lighted throughout by them with "Metro" burners. The drawing-room of the "sun-trap" house is treated in a manner which represents a decorative idea quite new to this country; the walls having been painted by Mr. Hayter by the "Zyte" process. It would be difficult to find a situation in which the soft, pleasing light of the incandescent burner could be emphasized to better advantage than here; and the result—in a house designed to sell at £1750—goes to show that gas lighting, properly applied, can successfully hold its place in better-class residences. The lights in the room referred to are of the semi-indirect type; the light source being obscured from view by artistic glass shells carried on wrought-iron wall brackets.

In the dining-room the fittings in natural bronze form an excellent complement to the Tudor decoration. The lighting is pleasing and well diffused; and the fact that the burners do not call for attention in the adjustment of gas regulator and air shutter, makes its appeal to visitors. The South Metropolitan Gas Company are to be congratulated upon the beautiful and eminently suitable silk shades used for lighting the den. To this room no doubt the occupier will retire to smoke and write his letters, while his wife may be busy there with the needle—sitting near a little table lamp, which will give her all the light required for doing the finest work without any eye strain.

Radiation Display.

Returning to the Main Hall, there is to be noted—in close proximity to the Joint Gas Exhibit, and, like it, depending for exterior illumination on "Flambeau" brackets, with flame coloured tulip-shaped shades—an island stand, the four sides of which are devoted to an unusually complete display of fires, cookers, water heaters, wash boilers, &c., made by the firms comprising Radiation, Ltd. These six firms are Messrs. Arden Hill & Co., of Birmingham; Messrs. Fletcher, Russell, & Co., Ltd., of Warrington; the Davis Gas Stove Company, Ltd., of Luton; the Richmond Gas Stove and Meter Company, Ltd., of Warrington; Messrs. Wilsons & Mathiesons, Ltd., of Leeds; and Messrs. John Wright & Co., of Birmingham. It is a more extensive display than we remember to have seen on previous similar occasions, and constitutes a revelation of the gas fire industry on the decorative side.

Without enumerating individual patterns, it may be said that there are on view Radiation patent "Injector-Ventilator" gas grates as constructed in numerous designs by the different Radiation firms. The "Injector-Ventilator" device is, of course, a specially constructed canopy with two flue openings, by means of which a thorough ventilation of the apartment is assured, without formation of draughts. The variety of designs is such that all interior schemes of decoration find a gas fire to suit them; and the surface "finishes" shown include copper, bronze, art silver, armour bright, and a new series in which the surface is overlaid with hard beaten metal, giving a most striking and refined effect. Gas fires suitable for "building-in" are also well represented; and the range of sizes will be found of great help in the planning of housing schemes, &c. The Wilson "Sunbeam"—"the gas fire like a coal fire"—is sure to maintain its interest for those people who like the appearance of the coal fire, but object to its dirt and trouble.

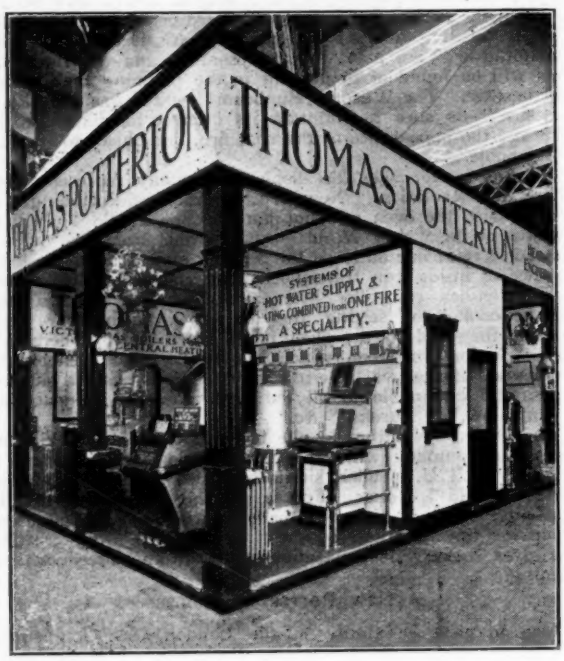
On the cooker side the display is equally representative. There are Radiation "New World" cookers, including examples with the oven and hot-plate on one level. The main features of the "New World" cooker ovens are: One burner instead of two; flue outlet at the bottom, instead of at the top; absence of inside iron framework; and the "Regulo" automatic oven-heat controller, by means of which a whole dinner can be cooked by setting the dial at a given figure and leaving the food in the oven for a given time. There are also "Junior" cookers, which are smaller and cheaper examples of the above, offering practically the same advantages, and obtainable in all the well-known series—such as "Bungalow," "Eureka," &c.

The Davis "Nautilus" coke boiler is shown in a kitchen recess, in company with a "New World" cooker; and a Wright "B.T.U." boiler, similarly placed in a recess with a "New World" cooker, offers a pleasing alternative that is "all-gas." A lady demonstrator is in attendance at the stand to answer any questions on the "New World" cooker; and she gives cookery demonstrations daily, in the afternoon and evening.

A New Potterton Boiler.

Also in close proximity to the London Gas Companies' exhibit is the stand of Thomas Potterton, of Ravenswood Road, Balham. This firm's display necessarily takes somewhat the same form as in previous years. An important addition on the present occasion, however, is a new "Victor" gas boiler for central heating work upon a large scale. Though the firm have in the past carried out quite a number of low-pressure hot water heating installations operated by "Victor" gas boilers, it has been necessary to employ batteries of boilers in cases involving more than 200 sq. ft. of radiation. Following the original design of "Victor" boilers, the principle of sectional construction with pipe couplings producing successive heating power is an essential feature of the new boiler; while the freedom from lime deposit occurring in this class of heater renders small waterways possible, and facilitates the assembly of sections into boiler units of varying capacities. The series is made in three standard sizes of five, seven, and nine sections. Ample provision is made for the cleaning of flues; all parts being accessible *in situ*. Each burner is provided with separate lighting door, and the burner mountings allow of easy removal for cleaning. A substantial base and condensation tray

combined is included; and the heat-losing surfaces are enclosed in an insulated steel jacket. Automatic control is recommended, for which rod or air thermostats can be supplied. Tests already carried out promise excellent results from this new boiler, to which it may be possible to refer in greater detail on a subsequent occasion.



The main part of the firm's "working exhibit" at Olympia takes the form of a "Victor" complete apparatus of the circular type, erected in conjunction with a "Domestikatum" boiler for the use of coke; this combination being what they consider to be one of the most economical types of apparatus from an initial standpoint, and also essentially economical to run—using coke for long-period duty in the winter months, and gas to meet summer requirements—supposing that gas is not regarded as the most favourable fuel to use at all times. From this working apparatus, hot water is taken to the sink for draw-off purposes, and to a towel rail on the same floor level—thus exemplifying an effective way of dealing with single-storey flats which it is desired to equip on the one level with towel rail and airing coils. There is also in action a complete apparatus of the rectangular series, which is eminently suitable for flats and other small buildings where the head pressure does not exceed 30 ft. This apparatus is being used as a stand-by, in order to show visitors with what extraordinary rapidity high-temperature water can be drawn from the "Victor" system.

An item of particular importance on the non-operative side of the exhibit is a "Victor" complete apparatus fitted-up in conjunction with a "Classic" coke boiler, for combined use in domestic hot water supply and heating work. There is also a sectional coke boiler for larger requirements, with one side of the jacket omitted, and a gap left in the sections for the purpose of showing the compact and effective plan upon which these boilers are modelled. Mention has already been made of the "Domestikatum" coke boiler, which is suitable for small houses, flats, &c. To meet the needs of hotels and institutions, there is the "Goliath" wrought welded heater, with internal cross tubes and waterway bottom. Also referring to coke apparatus, mention may be made of the "Victor-Combination" boiler set—*i.e.*, a gas boiler and a specially designed coke boiler—which has already proved its value. The lighting has been carried out by the South Metropolitan Gas Company in their customary attractive and efficient style.

"Metro-Log" Fires.

Readers who visited last year's Ideal Home Exhibition will recall the beautiful "Metro-Log" fire which was installed in the joint exhibit of the London Gas Companies. At the recent meeting of the South Metropolitan Gas Company, Dr. Charles Carpenter referred to this fire, which, he said, has met with a success quite beyond the Company's anticipations. Certainly, it possesses high artistic merit. Allusion has already been made to its inclusion in the prize house, where the realistic effect of the flames playing about the red-hot logs gives rise to much favourable comment; but in addition to this the "Metro-Log" fire forms a feature of several other displays, the attractiveness of each one of which it enhances. One can see it on the stands of the Leeds Fire Clay Company, Ltd., of the Telephone Development Association, and of Associated Crafts, Ltd. In the last-named case, the fire is not of standard size, but one specially made for Associated Crafts, for placing in a handsome Tudor fireplace. Here the fire is carried in a basket, and, with its setting, provides an amazingly exact representation of blazing logs. One of these fires also enlivens the sitting-room of another of the houses.

Empire Marketing Board.

A notable display is made in the New Hall gallery by the Empire Marketing Board, who show a very wide range of Dominion foods. Opposite the actual exhibits four fully fitted kitchens, equipped by the British Commercial Gas Association with gas cooking ranges, have been built. On these hourly demonstrations of the best methods of preparing and cooking Empire produce for the British table are given by certified cooks of the British School of Cookery. One kitchen is devoted to the preparation and cooking of meats and soups; another to puddings and dried fruits; a third to the 156 different ways of presenting potatoes on the dinner table (a special series of demonstrations arranged by the Ministry of Agriculture); and the last to demonstrations of Indian cookery, carried out by an Indian expert chef. The kitchens are all open to the public, who can walk round the ranges and sample the dishes exposed on the counters close by.

Further demonstrations are being carried out daily at the stand of the Good Housekeeping Institute, of 49, Wellington Street, Strand. The Institute have divided their space up into three sections—a gas kitchen, an electric kitchen, and a laundry; and all the equipment used has received the Institute's seal of approval.

Glass Melting by Gas.

In the portion of the New Hall gallery which is devoted to a demonstration of old English handicrafts, is staged a fascinating example of the making of decorative glassware. The South Metropolitan Gas Company were approached some time ago by the "Daily Mail," who asked them if they would be able to provide a furnace capable of melting glass and maintaining it at a working temperature. The problem in itself was not found to be beyond the resources of the Company's well-known research laboratories; but a difficulty lay in providing practicable working conditions in the very small space —12 ft. by 14 ft.—allotted for the purpose at Olympia. This difficulty was, however, surmounted; and so visitors are able to see glass made and shaped by hand in exactly the same way in which it was done very many years ago. We feel sure that any representative of a gas undertaking interested in this industrial application of gas who may desire to see "behind the scenes" at Olympia, will be granted every facility for examining the furnace and its gas burner on making application to the Company.

Briefly, it may be stated that the exhibit comprises a furnace containing two melting pots—one holding 1¼ cwt. of clear "metal," and the other ¾ cwt. of coloured "metal." By the side of the furnace stands a gas heated annealing oven, for finishing-off the products. Both furnace and annealing oven are, of course, of "Metro" design.

Food Preservation.

One feature of the exhibition pretty certain to strike the inquiring visitor is the number of refrigerators that are on view, of a size and style suitable for domestic use. A good deal of attention has lately been drawn to the fact that the new regulations which have come into force, and others which will come into force shortly, forbidding the use of harmful preservatives in food, must result in a large and rapidly growing demand for means whereby food may be maintained in a non-injurious condition in the home. For this a low temperature is necessary; and various exhibits show how this can be obtained with motorless refrigerators, which are neither prohibitive in cost nor difficult in operation.

The refrigerator of Electrolux, Ltd., of 153-5, Regent Street, W., which has been described in the "Journal" on previous occasions, is without a single mechanical moving part to call for attention. Once installed, with an attachment (say) to the gas main and water supply, it will continue to function indefinitely without adjustment, and at a trifling cost per day. Another appliance with which readers are acquainted, and which can also be operated with a very small consumption of gas or electricity, is the refrigerator of the Ice Stove Company, Ltd., of Victoria Station House, S.W. This is supplied in two forms for domestic use—the portable and the fixed semi-automatic. The portable pattern is easy to operate, and entails a negligible outlay on gas; while the only operation necessary with the automatic form is to switch on the heat.

Yet another type of motorless refrigerator to be seen at Olympia is that of the Pulsometer Engineering Company, Ltd., of Nine Elms Iron Works, Reading. This can be operated by gas or, like those just referred to, by other forms of heat. The outcome of many years' work, the "Pulsometer" refrigerator, in its different sizes, is suitable for hotels and also for bungalows. Extreme simplicity marks both the installation and operation of the appliance. Connecting-up to the water supply and the source of heat is all that has to be done. The heating period lasts only about 1¾ hours daily, and ceases auto-

matically. Refrigeration then goes on without any supervision for the remainder of the day.

Other Exhibits.

Gas heated water supplies form altogether a prominent feature of the exhibition. In addition to the Potterton installations already mentioned, there is a "Victor" complete apparatus on the stand of the Staines Kitchen Equipment Company, Ltd., and another on that of the Good Housekeeping Institute. For the burning of coke for water heating, Messrs. Jones & Attwood, Ltd., of Stourbridge, show the "Domestikatum" open-fire boiler for domestic use. The firm claim to be the originators of the open-fire type; and the "Domestikatum" has been kept fully up to date by various modern improvements, while a smaller size has been added which is specially suitable for small houses and housing schemes.

A number of cookers of the smaller type can be seen at various stands; and the same remark applies to open fires and closed stoves for coke. Again, there is a good display of their cookers by the New Stimex Gas Stove Company, Ltd., of Balham Hill; while the Falkirk Iron Company, Ltd., of 76, Wells Street, Oxford Street, W., feature "Smooth-top" gas ranges and "Falco" domestic hot water boilers. Messrs. Wood, Russell, & Co., Ltd., of 34, Oxford Street, W., draw attention to the "Sentry" gas fire and the "Sentry" boiler and oven; and Messrs. Candy & Co., Ltd., of 87, Newman Street, Oxford Street, W., to their "Devon" fires, which possess high artistic merit. Messrs. A. Bell & Co., of Kingswell Works, Northampton, show their new faience gas fires.

Water heaters are shown by Home Appliances, Ltd., of 42, Newgate Street, E.C.; Clarkhills, Ltd., of 27, Old Bond Street, W.; and others.

Water softeners on the "Permutit" system are to be seen at the stand of United Water Softeners, Ltd., of Aldwych House, London, W.C. This method is suitable for premises of all sizes. It requires no chemicals, has no moving parts, and can be fitted in any convenient position adjacent to the water main.

NOTES ON NEW BOOKS.

THE MARKETING PROBLEM.*

How the marketing problem is being tackled in the United States of America is the subject of a highly interesting book by E. T. Elbourne. The volume is the outcome of an extensive survey in U.S.A. by the author in July, August, and September of last year; and the contents certainly enable the British manufacturer to weigh up for himself the significance of American practice. There is a foreword by Sir Josiah Stamp in which he says that to bring back to this country a concise and detailed summary of American marketing devices, which may be studied and, where advisable, copied by English business men, is a service of much value. The author had many consultations with recognized leaders of business in America; and the numerous quotations, tables, and references in the book are the result of this work, and have been derived at first hand from authentic sources. "It will," states Mr. Elbourne in a short preface, "be a great satisfaction to the author if the reading of this book helps to foster a regard for the United States commensurate with that regard for England so abundantly evident to the visitor." We think this hope will be fulfilled.

The first chapter is entitled "Recent American Development." The author regards participation ownership of industrial concerns by the wage earners as the most significant recent development in American industry and business. Employers and employees are getting together, not merely round the same conference table, but on the same side of the table. This spirit of co-partnership is rightly fostered and properly practised in the gas industry in this country. As Sir David Milne-Watson remarked at the opening of Watson House in November last, it is no use preaching the blessings of capital if employers keep all the capital to themselves. In the Gas Light and Coke Company there are at present between 13,000 and 14,000 co-partners who hold no less than £500,000 of the ordinary stock of the Company. Last year, during the general strike, there was ample proof that co-partnership in the gas industry was not a theory to be used on occasion as a palliative, but a practical measure promoting that relationship between employer and employed which alone can make for successful working conditions. Another recent development in America is the increase in the number of students at institutions of higher learning. There are trained technical personnel in every avenue of production and distribution upon a scale vastly larger than possessed by any other nation. Then the workpeople are largely free from the economic fallacy that restriction of individual effort increases the number of jobs. The national unions have long since declared against such theories. While in the last dozen years the population in the United States has increased by 16 or 17 p.ct., the productivity of the nation has grown by 30 or 35 p.ct.

In Chapter II., which deals with commercial research, the value of co-operation between university schools of commerce and business houses is emphasized. Chapter III. gives a mass of particulars on official information service; and in Chapter IV. the important problem of waste elimination is considered in some detail. Real efforts are being made in America—and this applies also to England—to reduce the waste resulting from unnecessary multiplication of terms, sizes, and varieties, and that due to too many links in the distribution chain and too many chains in the system. Such problems as the reduction of seasonal employment in construction and other industries, and intermittent employment in such industries as bituminous coal, are being tackled with zest. The fact that in 1920 the wages rates were 199 (1913 = 100) and prices 226, while the corresponding figures for 1924 were 228 and 150 is put forward as proof of the value of America's work in the elimination of waste.

Chapters V. and VI. are devoted to consideration of trade association activities and auxiliary marketing services; while the subject of budgetary control is dealt with fully in Chapter VII. The author is enthusiastic about this system, which makes every departmental head his own chief cost accountant, and compels him to operate his department within definite bounds—a system which "is a brain on paper, which co-ordinates the various nerve centres, the divisions and departments." By adopting budgetary control—which is a sales, a production, and a financial guide—one corporation in America reduced its inventory from 170 million dollars to less than 90 million dollars, and did a larger business on the smaller inventory.

"The Marketing Counsel" is the title of Chapter VIII., and "Publication Surveys" that of Chapter IX., in which it is remarked that splendid work is being done by publishers of magazines, newspapers, and business papers in making marketing surveys and rendering marketing service. The author says that "the fact that it is done with the obvious object of selling more advertisement space does not detract from its usefulness." In the next chapter considerable attention is paid to the question of advertising. The following quotation is of interest: "The superficial talk to the effect that advertising pays has made advertising too haphazard, while the lack of exact data has been a matter of distinct disadvantage to those who desired to study the problem before making their advertising appropriations or deciding upon how those appropriations should be spent." At present there are undoubtedly large wastes in advertising—wastes for which the public pays. An interesting comparison in this chapter shows how space advertising and direct advertising can be combined to excellent advantage.

Institutional publicity and printed salesmanship are discussed in Chapters XI. and XII., and problems of distribution in Chapter XIII. The case for the middleman system is set out clearly. Middlemen achieve economies in two principal ways: By their skill in performing marketing functions through specialization; and by combining products made by different producers or manufacturers. If the latter cease selling through middlemen, they must store goods in different parts of the country, have capital tied up in large stocks, give credit to the retailer, break up their goods into small lots, send out scores of salesmen, and may have to make deliveries. The final chapter of the book deals with marketing literature.

To sum up, the book is of value to all interested in business and industry.

* "The Marketing Problem: How it is Being Tackled in the United States," by E. T. Elbourne, A.M.I.Mech.E., with a foreword by Sir Josiah Stamp, G.B.E., F.B.A. Published by Longmans, Green, & Co., Ltd.; price 10s. net.

Will.—Mr. J. W. Broadhead, of Northgate Mount, Honley, Managing Director of Messrs. Robert Dempster & Sons, Ltd., of Elland, left unsettled estate of the gross value of £30,649, with net personalty £18,292.

Spring Meeting of the Midland Association.—We are notified by the Hon. Secretary (Mr. T. Thornton) that the spring meeting of the Midland Association of Gas Engineers and Managers will be held at Dudley on Thursday, May 26.

Power Efficiency.—A Power Efficiency Exhibition is to be held in the City Hall, Manchester, from June 22 to July 2 next. It is intended to cover the whole field of the utilization of gaseous, liquid, and solid fuels, and of steam power. A section will be devoted to low-temperature carbonization. Numerous sub-sections are projected to cover practically all types of machinery and appliances connected with the generation of power. We understand many prominent firms are already represented. All inquiries should be addressed to Mr. Frank Nasmith, Director and Manager, Textile and Industrial Exhibitions, Ltd., 121, Deansgate, Manchester.

LONDON JUNIORS' 25th ANNIVERSARY CELEBRATION.

Splendid Progress of the Association.

Last Friday evening the London and Southern District Junior Gas Association celebrated their twenty-fifth anniversary by a dinner at the Criterion Restaurant, W.1. The spirit of enthusiasm which characterized the band of pioneers who laid the foundation stones of the Association so securely is as evident to-day as it was twenty-five years ago; and it is to this spirit more perhaps than to any other factor that the Association owes its unquestioned success. That the Junior Movement enormously benefits the gas industry is now an accepted fact; but this was not the case during the early years of the present century. In those days it was, perhaps, regarded by some few either as a disruptive change or, worse still, as a foolish venture to be treated with tolerant good-humour until its momentum was spent and everything settled-down once again to the old norm. The sterling work of the pioneers of the Association, however, soon commanded respect and attention. Non-recognition of such excellent and productive work would, indeed, have been a confession of weakness on the part of those who ruled the destinies of the various gas undertakings, and through these undertakings the destiny of the industry itself; and any sceptical views which may at first have been held soon gave way to active support. The London and Southern District Association—in common with the other Junior Associations—are keenly appreciative of this support of the Senior Associations, and are grateful for it.

Formation and Progress of the Association.

At the dinner on Friday last, gracious acknowledgment was made of the assistance the Association received from the Senior Associations and also from the Technical Press. As a matter of fact, the "JOURNAL" really acted as midwife at its birth. The first meeting was held at the Regent Street Polytechnic on Oct. 27, 1902, when Mr. Walter Grafton (Chemist at the Beckton Works of the Gas Light and Coke Conmpany, and a teacher of gas manufacture at the Polytechnic; now with the City of Glasgow Gas Department) was elected President, and Mr. J. M. Campbell (now Engineer and General Manager of the Isle of Thanet Gas Company) was appointed Senior Vice-President. The first annual general business meeting took place at the Polytechnic on May 15, 1903; and it was here that for four years the members held their meetings. Then, in 1906, they moved to the Cripplegate Institute. Another four years passed, after which the meeting place became the Westminster Technical Institute—the headquarters of the Association to-day. Since its formation, the Association has grown from strength to strength; and the present membership is no less than 324. The record of its activities is in itself adequate proof of the Association's valuable help in the progress of a great industry.

A Distinguished Gathering.

Prior to the dinner the President, Mr. Arthur Broadbent, and Mrs. Broadbent received the guests, among whom were Messrs. J. Wilkinson, O.B.E. (President of the Institution of Gas Engineers), T. Hardie (Chief Engineer of the Gas Light and Coke Company), F. W. Goodenough, C.B.E. (Controller of Sales, Gas Light and Coke Company), F. C. Briggs (President of the Midland Association of Gas Engineers and Managers), J. Terrace (Chief Engineer of the South Suburban Gas Company), Stephen Lacey (Deputy Controller of Sales, Gas Light and Coke Company), and J. W. Buckley (Engineer and General Manager of the Hornsey Gas Company).

It is customary at the Association's annual dinners to have musical entertainment; but the introduction of community singing last Friday was an innovation. It was, however, particularly apt, and proved an unqualified success—perhaps due to the fact that the essence of community singing is co-operation, and that team-work is the principle of the Association.

After-Dinner Speeches.

After the Loyal Toast had been honoured,

Mr. J. WILKINSON, proposing the toast "The Association," said that among those responsible for the formation of the Association were many with whom he was acquainted. He well remembered Mr. Walter Grafton, their first President; and he had had several happy hours with him at meetings of the Institution. Then there was Mr. H. D. Madden, of Cardiff, Senior Vice-President of the Institution, and Mr. J. M. Campbell, of Margate. The Association had progressed excellently until the war, when their operations had to be curtailed; and since the war their progress in regard to status, standard of work, and membership had been rapid. Their President during the 1924-25 session—Mr. W. Newton Booth, of Woolwich Arsenal—was an old colleague. The gas industry, said Mr. Wilkinson, was just as much alive to-day as it was 110 years ago. It was an industry they were all proud to serve, and the work in it was truly fascinating, and made each working day seem all too short. Not only the chief product—gas—but also the various bye-products benefited, and brought comfort to, millions of people. The future of this great industry was in the hands of the London and Southern District Junior Gas Association and kindred Associations; and there could be no fear regarding the future when they realized that the young men in the industry were willing to work hard to promote its welfare. No doubt many of the juniors to-day would in time to come fill important positions.

Mr. LEONARD LACEY, who replied to the toast, remarked how fortunate they were to have with them the President of the Institution of Gas Engineers and so many distinguished guests. The Association had been founded in 1902 by a zealous band of enthusiasts; and since then the number of members had increased until now there were over 300 members drawn from many branches of the industry. Though they were designated a "Junior Association," there was no compulsory retiring age; and it was good to see so many of the older members with them that night. The Junior Associations of the country generally had always received support from the Senior Associations; and the ties had been strengthened recently by affiliation and by their joint interest in the Education Scheme of the Institution of Gas Engineers. During the war the activities of the Association were curtailed, but they did not cease. Mr. S. B. Chandler, of the Tottenham District Light, Heat, and Power Company, had acted as their President throughout the troublous war period, and had carried on in a manner for which they were all extremely grateful.

Mr. P. F. SCARFE, the first Hon. Secretary of the Association, also replied to the toast proposed by Mr. Wilkinson. He said that Mr. Campbell's letter to the Technical Press in 1902 was the starting point in their career. It was this letter which led to Mr. Walter Grafton, who was at that time teaching the subject of gas manufacture at the Polytechnic, to call his students together; and from this the Association was formed. Many in the gas industry were indebted to Mr. Grafton for his help in their studies. The Association also owed a great deal to the leading members of the industry, who had held out a helping hand, and to the Technical Press, who had always assisted their work. Mr. Scarfe congratulated the President of the Council of the Association for the excellent programme which had been arranged for the 1926-27 session. As for the strength of the Association, this was well indicated by the membership. One of the chief advantages of the Association was that it helped a man to realize his possibilities. The reading of papers and their discussion broadened his outlook, and thus rendered him better able to serve his employers and, incidentally, himself. It was a case of mutual advantage.

The toast of "The Visitors" was proposed by Capt. W. J. LIBERTY, a Past-President of the Association. Calling attention to the number of distinguished visitors, he said how honoured the Association was by their presence.

Mrs. NEWTON BOOTH, in a neat and happy speech, replied on behalf of the ladies, saying how conscious she was of the compliment paid to her sex in allowing them to speak for themselves. Last year the rules of the Association had been altered, and now ladies could be admitted, provided they consented to be regarded as "persons." It had taken a century before the London Junior Gas Association had been founded, and a further quarter of a century before ladies were allowed to join—and this in spite of the fact that they were acknowledged to be good "retorters." [Laughter.]

Mr. T. HARDIE (Chief Engineer to the Gas Light and Coke Company, and President of the Southern Association of Gas Engineers and Managers) remarked that the London and Southern District Junior Gas Association was perhaps the most important of the Junior Associations. The London Companies alone were responsible for nearly a quarter of the total gas produced in the country; and when it was taken into account that many engineer-members of the Association were outside the London district, the Association drew its members from an area responsible for perhaps one-third of the gas used in the country. Mr. Hardie described the Association as a "live" one, and said how pleased he was to note the number of works they visited. There was nothing like getting to know what others in the industry were doing. It was a fact that the juniors were the men who really did the hard work; the others reaped the advantage of it.

Mr. W. L. WESTBROOK (last year's President) proposed the toast of "The President." Mr. Broadbent, he said, had had many years' experience on the sales side of the gas industry, his first experience being gained in America. He joined the Gas Light and Coke Company in 1904, directly after the formation of the Sales Department, and had been on Mr. Goodenough's staff since then. He was an expert in the mysteries of labour analysis. He had been a member of the Association for over twenty years, had served on the Council for seven years, and had acted as Hon. Treasurer during the period 1920-25. He had given several papers, and had always taken an active part in discussions. Those on the Council knew of the good work he had done; and as President of the Association he had conducted their affairs with skill and efficiency.

Mr. BROADBENT, in reply, said that, as they looked back on the early days of the Association, and thought of the progress made since then, they must all realize what a deep debt of gratitude they owed to the unbounded enthusiasm of the pioneers. Having dealt briefly with the history of the Association, Mr. Broadbent said he had received a letter from Mr. Walter Grafton. In that letter their first President observed that the twenty-fifth anniversary of the Association was an important event, and expressed his regret at his inability to be present at their celebration dinner. "That such an Association was needed," wrote Mr. Grafton, "is shown by its exceptionally successful career in promoting the well-being not only of the individual members, but of the gas industry itself. The general public are the better for the initiative of the individual members of the Association in seeing that gas is a better and more reliable servant in the home than ever before. The Association is not a little indebted to the Regent Street Polytechnic for the assistance it rendered during the early days of the Association. . . . To-day is the day to claim its birthright, and to aspire to still higher things." Mr. Broadbent

observed that to-day the Association was virile, and its growth was justified by its utility.

The toast of "The Secretary and Treasurer" should have been in the hands of Mr. W. T. Kenshole, of Lea Bridge, but owing to illness he was unable to be present at the dinner; and Mr. F. S. LARKIN, of the Gas Light and Coke Company, proposed it. Following the replies of Mr. J. H. GOLDSMITH, the Hon. Secretary, and Mr. H. F. G. SOAR, the Hon. Treasurer, the remaining toast of "The Press" was submitted by Mr. J. H. CLARK, of the Gas Light and Coke Company.

MANCHESTER DISTRICT INSTITUTION OF GAS ENGINEERS.

FIFTY-SEVENTH ANNUAL MEETING.

The Fifty-Seventh Annual Meeting of the Manchester District Institution of Gas Engineers was held on Friday, March 4, at the Midland Hotel, Manchester—Mr. C. S. SHAPLEY, of Leeds (the President), in the chair.

The minutes of the previous meeting were taken as read, and confirmed.

THE PRESIDENT'S STATEMENT.

The PRESIDENT said he was a comparatively young member of the Institution, having joined in 1909; and he recalled how at that time he looked—he might say with awe—on those who were seated at the head of the table, never thinking that the time would come when he himself would occupy the office of President. He was glad to be in that honourable position; and he believed he was expressing the feelings of the younger members in saying they were very pleased to see so many of the Past Presidents present on this occasion. They, with those who had passed away, had been the backbone of the Institution in the past; and it was due to the fine work they had put in that it was now, if it would assert itself, the most prominent Institution in the British Isles. He was sorry that he must add a word of warning. It was incumbent upon him to point out that they had not a single elected member on the Council of the Institution of Gas Engineers. That was a standing disgrace. It showed clearly that the members did not vote for their own nominees. Mr. Tagg, who was their President two years ago, was sitting on that Council by reason of being a Vice-President of the Institution. He himself (Mr. Shapley), through the kind offices of the members, was there representing the Manchester district; but there was no elected member from the Manchester district. Three nominees were being put forward this year; and they were all good ones—Mr. G. S. Frith (a Past President), Mr. R. E. Gibson (another Past President), and Mr. W. J. Smith, of Bolton. It was the wish of the Committee that the members should give their votes to those three representatives, in order that they might be sure to carry one.

NEW MEMBERS.

The following new members were announced:

Mr. John B. Balmforth, Bingley.
Mr. George E. Currier, Meadow Lane Gas-Works, Leeds.
Mr. John Lupton, Windermere.

Mr. E. H. HUDSON (Normanton) moved the adoption of the annual report and statement of accounts, The motion was seconded by Mr. WOODWARD, and agreed to unanimously.

REPORTS OF COMMERCIAL SECTIONS.

Mr. S. MEUNIER (Stockport) submitted the report of the Lancashire Commercial Section for the year ended Dec. 31, and said the meetings had been well attended, and good work had been done. In the report attention was drawn to the coal strike. They all knew what this had entailed. Nearly 400,000 tons of foreign coal were imported into the Manchester area; and the work of dividing it up was carried out excellently. Credit was due to the District Secretary of the National Gas Council for the magnificent work he put in. ["Hear, hear."] It required keen business ability, and entailed an enormous amount of labour; and the results had been satisfactory all round. He believed everyone was highly delighted. They had done very well with tar in the Manchester district; and this had helped them somewhat.

Mr. F. SIDWELL (Winsford) seconded the adoption of the report, which was adopted unanimously.

Mr. E. H. HUDSON (Normanton) presented the report of the Yorkshire Commercial Section, and also referred to the splendid work done in connection with the importation of coal. Great gratitude was due to their old friend, Mr. Frank Richmond ["Hear, hear."], who kept the works in Yorkshire going. He did not know of any case where there was a shortage of gas during the whole period. He had read the report of the Lancashire Commercial Section, and was interested to see that that body had fallen into line with the co-operative tar scheme. In doing so they had entered on very intricate work, which would demand a great deal of consideration and time on the part of some members of the Section. In Yorkshire they launched their scheme in October last, and had every reason to be gratified with the results. They scarcely knew yet what the ascertainment would be at the end of the first accounting period; but they felt they were working for the common good, and he had no doubt that it was the best system of selling tar which had come before the industry during his time. There was a note of sadness in the report, which alluded to the loss of their old friend Mr. F. H. Pickles, who was for years Secretary of the Yorkshire Commercial Section—a most genial man, and courteous in every way. Then the concluding paragraph referred to the illness of their President, Mr. Charles Wood, who had felt it incumbent upon him to resign his position as Engineer to the Bradford Corporation Gas Department. They all hoped that in a quieter walk of life he would renew his health and enjoy many years of retirement. Though they felt his loss very severely, they rejoiced to think that this action of his might be conducive to his speedy recovery.

Mr. R. WATSON (Doncaster), seconding the adoption of the report, said he associated himself with Mr. Hudson in regretting very much the loss of Mr. Wood, who had been of great service to the Section. Incidentally he might say that Mr. Hudson had been an able lieutenant of Mr. Wood; and they were glad that he had been able to carry on as President of the Section.

The report was adopted unanimously.

The PRESIDENT proposed, and it was agreed, that a suitable letter be sent from the Institution to Mr. Wood, wishing him a speedy recovery, and expressing the hope of the members that they would have him among them again.

CONTRIBUTIONS TO THE INSTITUTION BENEVOLENT FUND.

Mr. S. MEUNIER (Stockport) moved that the usual sum of ten guineas be granted to the Benevolent Fund of the Institution of Gas Engineers.

Mr. S. CARTER (Liverpool) seconded the resolution, which was agreed to.

The PRESIDENT said the next recommendation of the Committee was that, in addition to the annual grant of ten guineas, a special donation of ten guineas be made to the Benevolent Fund this year. Mr. J. Wilkinson, one of their members, was the President; and it was thought it would be fitting to show their appreciation of his services by supporting the Benevolent Fund, in which he took great interest. An intimation to this effect was given by Mr. Frith at the Benevolent Fund meeting; and it drew from Mr. Wilkinson a letter to their Secretary, Mr. W. Rogerson. In this letter, Mr. Wilkinson expressed his regret that he could not attend the meeting that day, in consequence of having previously accepted an engagement in London in connection with the Institution of Gas Engineers. He asked the Secretary to explain the reason for his absence. At the same time, he took the opportunity to express, as President of the Institution of Gas Engineers, the greatest possible pleasure at the recommendation of the Council.

Mr. S. GLOVER (St. Helens) emphasized the fact that this special gift was not only a compliment to the Institution of Gas Engineers, but would also be a very helpful contribution to the good work which the Benevolent Fund was carrying on. He moved that the special donation of ten guineas be made to the Benevolent Fund.

Mr. HUDSON seconded the motion, which was carried.

RE-ELECTION OF OFFICERS.

The PRESIDENT said the next item was the confirmation of the Committee's recommendation that, owing to the general strike, the coal strike, and the consequent curtailment of the activities of the Institution during the past year, the whole of the officers should continue in office for another year. He entered a strong protest against that recommendation, because he felt it was only fair that the Vice-President should take the office of President. But it was the wish of the Committee that the proposal should go forward, and it was for the members to decide.

Mr. HUDSON said it would have been a great hardship if Mr. Shapley's tenure of the Presidency had been restricted to a year like 1926. The passing of this resolution would give him an opportunity of showing to the members his worth, ability, and administrative powers. He proposed that the President and all the officers continue in office for another year.

Mr. J. C. BELTON (Chester) seconded the resolution, and it was carried unanimously.

The PRESIDENT said he felt honoured by this vote of the members. He was sorry that his Chairman, who had been ill for some time, was not present to give the members a cordial invitation to visit Leeds later on in the year. He thought the October meeting might be held in Leeds, if the members would sanction it. Last year it was decided to visit Messrs. Earle's works; and he understood the Committee had arranged that visit for Friday, May 6.

REPRESENTATIVES OF THE INSTITUTION.

Mr. F. H. ROBINSON (Harrogate) moved that Mr. Shapley be

appointed the representative of the Institution on the Council of the Institution of Gas Engineers.

Mr. W. Hill (Sandbach) seconded the resolution, which was carried.

Messrs. W. Buckley (Manchester) and W. B. McLusky (Halifax) were appointed representatives of the Institution on the Councils of the Manchester and Yorkshire Junior Associations respectively.

Presentation of Tokens to Past Presidents.

The President said that the Committee, after careful consideration, had resolved that some token or badge should be presented to Past Presidents of the Institution, to mark their year of office, and the esteem and respect of the members; and that a similar token be presented to future Presidents on the completion of their year of office. The Committee had appointed a Sub-Committee to purchase suitable tokens. He moved that the recommendation be agreed to.

Mr. R. H. Ginman (Leek) seconded the resolution; and it was carried unanimously.

Mr. Kendrick's Death.

The President said it was delightful to have so many of the Past Presidents present. He must, however, express his regret that one of them, for whom a token had been struck, had just passed away. He referred to Mr. H. Kendrick, of Stretford. They would honour him by rising for a moment. [The members did so.] He was sure they would wish Mr. Kendrick's token to be passed on to his widow. He would ask Mr. Bridge to present the token to Mrs. Kendrick.

Mr. J. Bridge (Elland) said the duty imposed upon him of conveying the token to the widow and family of his old chief was an honour. For ten years he was assistant to Mr. Kendrick at the Stretford Works; and he had very great esteem for his old chief. In conversation with Mrs. Kendrick, they had discussed the Institution and other matters; and she was very pleased when she knew that her husband's name would be engraved on the token, and that it would be sent to her.

The President said Mr. Bridge, with his artistic mind, had been mainly responsible for the design of the token. It was not a pretentious badge. On one side was a representation of a white rose, and on the other of a red rose. There was a small portion of the Manchester coat of arms, and an inscription: "Manchester District Institution of Gas Engineers, President"—and then the year of Presidency, with the monogram of the recipient in the centre. His name was on the back. It could be fastened by a pin, and worn at public functions. He then proceeded to present the tokens to those Past Presidents who were present. The list which had been prepared included 26 names. The following six gentlemen were unable to attend: Messrs. W. S. Haddock (1898), T. N. Ritson (1900), C. Wood (1901), S. R. Ogden (1903), J. W. Morrison (1909), and E. A. Harman (1916).

Replies by Past Presidents.

Mr. T. Banbury Ball (1898), thanked the Committee heartily for this handsome gift. He mentioned that he was, by their courtesy, an honorary member of the Institution.

Mr. R. G. Shadbolt (1899) said the token was a very happy idea. If any occasion was likely to give rise to retrospection, it was one such as the present; and his mind went back to the time when he first became a member of the Institution. Speaking from memory, he thought the membership at that time was somewhere in the neighbourhood of 60; to-day it almost reached 200. To have helped, even in a small way, to bring about this happy state of affairs was no mean achievement. He recalled that at that time very few Yorkshire names appeared on the membership roll. There was a strong feeling that they should emulate Lancashire by forming a similar Association for Yorkshire; but he and one or two others took a rather wider view, and came to the conclusion that one strong Institution was far preferable to two weak ones. They brought other Yorkshire members over to that view, so they joined forces; the Yorkshire members got representation on the Committee; and some of them, including himself, were ultimately honoured by election as President. He hoped the success obtained so far would continue.

The President said Mr. Ritson (1900) had written a letter to the Secretary in which he said the presentation of the token was a kind and thoughtful act.

Mr. H. Townsend (1904) said it was a great delight to be once more among them. He always attended the meetings of the Institution with great pleasure and profit; and he had a warm corner in his heart for the Manchester District Institution. Never had he felt as proud of the gas industry and the managers as he did during the coal strike. They had kept the flag flying, and deserved well of the nation.

Mr. S. Meunier (1905) remarked that this was one of the most pleasant surprises he had ever had. It was something he never expected, because he did not think he deserved it. One of the things which stood out most prominently in his own mind as having marked his year of office was his Presidential Address. It took him two years to work it out; and when he had presented it, he believed nobody understood it. [Laughter.] He had followed up with great success to himself the principle which he tried then to lay down; but evidently other people had not quite the same faith in it, and left it severely alone.

Mr. J. H. Brearley (1906) associated himself with previous speakers in thanking the person who had had the wonderful inspiration to introduce this nice little tonic for the meeting. It was just 21 years since he was President, and looking at the list of Past Presidents he observed that only about nine of those who preceded him in office had survived. That gave rise to a feeling of sadness; but he was pleased to observe that of those who had followed him all but two were alive. He hoped they would live many years, and help along the younger members of the industry, of which they were all proud.

Mr. W. Prince (1907) expressed his appreciation of the token. He congratulated the President and the members on the wonderful growth of the Institution.

Mr. T. Duxbury (1908) agreed that it was a happy thought to present these tokens of services rendered in the past. He thanked the members for honouring him with the Presidency of so important an Institution. Many suggestions had been sent to London, and most of them had been carried through, because they were good.

The President remarked that he was exceedingly sorry Mr. J. W. Morrison (1909) was unable through sickness to attend. For 7½ years he worked with Mr. Morrison at Sheffield; and it was Mr. Morrison who introduced him to the Institution, which he joined in 1909.

Mr. R. Watson (1911) thanked the members heartily for this interesting memento of whatever slight services he might have rendered to the Institution. He came up from the London district in 1902, and joined the Institution in December of that year. What particularly gratified him was the hearty welcome which he received from the members at the time. Knowing the record of the Institution and the work it had done, he felt great pleasure in being present and receiving this token.

Mr. S. Glover (1912) said he was very much touched at being associated with so many of his veteran friends in the honour of receiving this token of the members' remembrance of services rendered to the Manchester District Institution. He hoped every recipient would cherish the recollection of this day, and of the long association with the Institution of which this token was a reminder. Some of them had travelled a hard road. They kept on treading it; and they were always stimulated by the kindly welcome they received from their young friends, and by assembling together for the good of the industry, to which he hoped they had all been of some help. The honour of being a Past President he esteemed highly.

Mr. J. C. Belton (1913) said it gave him great pleasure to be among the members, and to meet so many old friends. His year of office as President he looked back upon as the happiest year of his professional life. During the war he was not serving the gas industry, but the Ministry of Munitions; and perhaps he had to do some things which were not pleasant to everyone. But he said without hesitation that the country was never so well served by any particular body of men as it was by the gas industry and the gas engineers during the war. It was a great thing to have been President of an Institution such as this, which had an influence upon the gas industry all over the world. One could not go to any part of the world where the Manchester District Institution was a stranger. He had a son in gas circles in New Zealand; and his greatest friends out there were former members of the Manchester Institution.

The President said he would make the next presentation a little out of order. Mr. Tagg had come to the meeting at considerable inconvenience, and desired to leave early, as his wife was seriously ill. During Mr. Tagg's year of office, he (Mr. Shapley) was a member of the Committee; and he wanted to say that Mr. Tagg did his job as President in no mean way. He raised the tone of the Institution.

Mr. S. Tagg (1921) said an outstanding feature of the gas industry was the fact that right through its ranks there was a feeling of friendship and goodwill of which the presentation of these badges was a token.

The President stated that Mr. E. A. Harman (1916), who was unable to be present, sent his thanks for the kind thought which prompted this acknowledgment of the services of Past Presidents. He was sure it would increase the affection and esteem they had for the Institution, and would act as a stimulus to all concerned.

Mr. W. Whatmough (1917) said he had had happy years in connection with the Manchester District Institution, and it was his great privilege to have occupied every position which the Institution could offer, from Auditor to President. He had also been Secretary of the Commercial Section. One great pleasure was to have been Joint Secretary with their late friend Mr. Kendrick.

Mr. J. P. Leather (1918) remarked that he was now away from Lancashire, and had to travel some distance to come to the meeting. When he received the letter of invitation, he was thankful not only for the honour it was proposed to confer on him, but because it was a special reason for coming. He felt he would meet many old friends whom he would not see at an ordinary meeting of the Institution.

Mr. A. E. Mottram (1919) thought the presentation was a good idea. He was pleased to receive the handsome token.

Mr. E. H. Hudson (1920) said he happened to be the representative of a small works; and that gave rise to the thought, which he pressed upon the attention of the bulk of the members who represented small works, that each of them could

aspire to the honour of being President. This honour, however, could only be achieved by interest, effort, and loyalty to the governing body. Interest was shown by becoming a member; effort, by contributing in a practical way in the shape of papers or taking part in debates; and loyalty, by abiding by the decisions of the governing body. In his younger days he obeyed those rules. He recalled that he had had the distinguished honour of being President during the jubilee year.

Mr. H. DAVIES (1922) said the token was a memento of a very pleasant year which he had enjoyed as President; and he thanked the members sincerely for it.

Mr. R. E. GIBSON (1923) greatly appreciated this kindly thought. He looked back upon his year of Presidency with much pleasure.

Mr. G. S. FRITH (1924) said he was proposed for membership of the Institution in 1898 by the late Mr. Isaac Carr; and he was glad to think they had present a son of that gentleman, who was showing great promise. They had some very good rising men in the Institution.

Mr. F. H. ROBINSON (1925) appreciated the badge as a memento of his year of office, and also because it was a token that Lancashire and Yorkshire now stood together. United they stood; if divided they would fall.

The HON. SECRETARY said that, having gone through the list of Presidents since the foundation of the Institution, he found that since 1872 only one had held the office for more than a year. This was the late Mr. J. G. Newbigging, who was President in 1914 and 1915. The design and the making of the tokens had been left entirely to the President and Mr. Bridge; and the President had omitted his own name from that list. He had now finished one year of office, and was starting a second year. When he was presented with a token next year, some addition should be made to it which would indicate that Mr. Shapley had served a second year as President.

Mr. S. GLOVER proposed that the meeting instruct the Committee that at the close of Mr. Shapley's second year the token presented to him should have a bar added, or something of that nature, in recognition of the fact that his Presidency had extended over two years.

The proposal was assented to unanimously.

PRESENTATION OF CERTIFICATES TO SUCCESSFUL CANDIDATES.

The PRESIDENT said the next item was the presentation of Higher Grade Certificates to successful candidates in the area of the Institution. They had present a representative of the Institution Education Scheme, in the person of Mr. Glover, who would perhaps say a few words.

Mr. S. GLOVER pointed out that the facilities now offered by the Institution of Gas Engineers' Education Scheme did not consist merely of an examination. That should be made clear. Facilities were offered to men who wanted to study, and who desired their studies to be guided to the best end. They were being helpted enormously throughout the country. Details were being considered and reconsidered, in order to perfect the scheme. Every report that came to them through their friend Mr. Bridge and others was given most careful consideration. Looking back he recalled the lack of facilities forty or fifty years ago. He hoped the members would encourage and help in every way assistants and others who went through the course laid down by the Institution of Gas Engineers.

Higher Grade Certificates were presented to:
P. Gallagher, Hindsford, Atherton.
W. P. Smith, Deane, Bolton.
D. Benson, Bolton.
T. A. Canning, Dewsbury.
T. Haworth, Oswaldtwistle.
J. R. Owen, Halifax.
J. C. Barwick, Keighley.

The following successful candidates were not present to receive their certificates:

J. H. Shadbolt, Newton Heath.
L. W. Harrison, Barnsley.
W. E. Stephenson, South Bank.
L. R. Cowley, Shipley.

DONATION TO LEEDS UNIVERSITY, FUEL SECTION.

The HON. SECRETARY moved that confirmation be given to the Committee's recommendation that the sum of 20 guineas be subscribed from the funds of the Institution as a special donation to the Leeds University, Fuel Section. To a certain extent this was a compliment similar to that paid to Mr. Wilkinson by giving a special donation of ten guineas to the Benevolent Fund. Leeds was the home of the President, Mr. Shapley; and it was voted for the good work which had been done by Prof. Cobb in the Fuel Section of the University.

Mr. W. HILL (Stalybridge) seconded the resolution, which was carried unanimously.

MATTERS OF INTEREST IN CONNECTION WITH WORKS NOT EXCEEDING 200 MILLIONS OUTPUT PER ANNUM.

AN INFORMAL DISCUSSION.

The PRESIDENT said the next item was an informal discussion on matters of interest in connection with works not exceeding 200 millions output per annum. This was a novel idea; and he hoped there would be an interesting discussion.

Mr. J. H. BREARLEY (Southport) said that during the last twenty or twenty-five years he had been closely connected with many small gas-works; and he was very much concerned about the position of the smaller works. In his opinion, the small works did not get adequate chemical supervision, and he had been wondering whether it would not be possible to arrange some co-operative scheme. It might be done either through an Institution such as theirs, or by co-operation with bigger works. In these days when statutory obligations were so important, it should be possible for any small works to call in, without any difficulty, the aid of an expert chemist to wrestle with their problems. The thought occurred to him that it would even pay the gas industry to have its own scheme of inspection of small works, whereby a man could be sent once a year to inspect these works—a man of great experience who would be paid for his services out of the funds of the industry generally, and not by the small works. The small works were the outposts of the gas industry. They could in no mean degree either make or mar the reputation of the industry; and if the small works were to give a bad name to gas, this bad reputation would percolate into the bigger towns. It was important, therefore, that the small works should be kept up to the highest standard attainable, both in their own interests and in the interests of the bigger works. To some extent the smaller works were the Cinderella of the gas industry, and he was not sure that the central bodies had taken quite as much interest in them and their requirements as ought to be taken. There was a great deal of talk about amalgamating the smaller works with the bigger undertakings. This movement would grow in the near future, because only by amalgamation and uniformity would the keener competition of the future be effectively met. He had been delving recently into the Reports of the Electricity Commissioners for the years 1923 and 1924, and had also gone into the figures for 1925. These clearly showed that the competition from electricity was growing. Electricity was being cheapened at a much greater rate than gas, and it was therefore very important that the gas industry should strengthen its ranks. Whether the smaller works remained as a separate entity, or amalgamated with the bigger works, there could be no question that they must be brought up to the highest pitch of attainment.

The CHAIRMAN said he considered Mr. Brearley had raised a very important point. The smaller works would most certainly have severe competition from electricity in the future. The sort of competition they would have to meet when the Government Electricity Scheme was in operation would be, he imagined, of the type which was already being met in the larger towns such as Liverpool, Newcastle, and Leeds. In Leeds they were cheered up by a confession from the City Electrical Engineer that he was making electricity in Leeds as cheap as modern brains could devise machinery to do so. So they in Leeds were in the happy position of having competition with them at the present time. This competition was an all-round manufacturing and distributing charge of 0·47d. per unit—a fairly low figure. The average selling price in Leeds was 1·49d., and the average price on the rateable value of about twenty houses was 1·48d. He thought that the figure they ought to look to, having regard to the fact that the gas industry had always looked well ahead, was a figure of about 0·75d. per unit. He was absolutely in sympathy with the idea that the larger undertakings ought to render assistance—he did not say gratuitously, but most certainly at cost price—to the smaller undertakings that might desire the services of a competent chemist. They could very well do so, because they could always spare a member of their staff for an emergency.

Mr. A. L. JENNINGS (Spenborough) remarked that, while the larger undertakings were able to employ one, two, or three chemists, of whom at least one was a highly-trained scientific man, those facilities were not open to the smaller works. The latter, however, ought to be able to turn to one of the universities—such as the Leeds University—for a chemist to carry out for a period any research work that might be required by them. He thought that tar for road purposes would be in very much better favour with surveyors if there was a chemist to whom the surveyors could refer the tar to see whether it conformed with No. 1 or No. 2 specification. Though he did not come within the category of works which were under 200 million capacity, he would like to mention a matter which arose at the Spenborough undertaking in October last. On Oct. 8 sulphur compounds could be detected in the town gas. A continuous sulphuretted hydrogen test showed it absolutely clear. The test for calorific value was 2 B.Th.U. above the declared quality of 450 B.Th.U. He suspected there must be something wrong with the purifiers; but he examined them, and found them normal. He then went to the washers and scrubbers, and found that the gas smelt entirely different from usual, and that, in the products from a bunsen burner, sulphur compounds were most noticeable. They tested for sulphur compounds at the exhausters, and found that they were getting a high content. It was obvious that the trouble was occurring in the retort house. They obtained a sample of each of six different coals, and ran through the tests, finding that they had in their plant an English coal which contained 4¼ p.ct. of sulphur. Thus gas might be absolutely satisfactory in its calorific value, and absolutely free from sulphuretted hydrogen, and yet be unsatisfactory owing to its high content of sulphur compounds. He thought there were many engineers who were under the impression that, if the gas conformed to the calorific standard and the sulphuretted hydrogen test, then the gas supply was entirely satisfactory; but it did seem that, if they were not using their normal coal, but buying job lots of coal, with the nature of which they were not conversant, the trouble he had alluded to was something which other people might with advantage be warned against.

Mr. W. BUCKLEY (Droylsden) said that the question of a Committee of Control was some years ago dealt with by a Committee of the Institution, and a report was prepared; but it was allowed to lie on the table, where he presumed it still was. There were about 200 undertakings in the area which might readily take advantage of a chemist if they had one to call on. At a cost of about £10

a year per undertaking, he thought those 200 smaller works could have provided for them at the Manchester College of Technology a laboratory with an assistant who would be at the call of any of the undertakings. He believed that if the College were approached, they would find the head of the Fuel Section entirely in favour of such a scheme. There was little doubt that they ought to have more chemical control in the smaller works, which could not afford to maintain a fully trained man, but could well afford to pay £10 a year for special services from the College of Technology.

With regard to the question of sulphur in coal, what Mr. Jennings had mentioned was very interesting. He had recently been asked the question whether there was any relation between the sulphur in the coal and the sulphur in the purified gas. He had a notion that there was to a certain extent, but not very close. So, for curiosity, he had tabulated 25 separate samples of coal in which the sulphur was known; and he found that there was practically no definite relation between the quantity of sulphur in the original coal and the quantity of sulphur compounds in the purified gas. With a relatively low sulphur content in the coal, one might get much higher sulphur in the purified gas than from coal with a higher sulphur content. They knew there was sulphur in coal and in the purified gas; but the question was, What was the determining factor in the production of CS_2 under modern retorting conditions?

Mr. J. P. Leather (Letchworth) remarked that, when he was President of the Institution in 1918, he offered the services of their laboratory at Burnley to any undertaking within a reasonable distance which desired assistance; but he did not remember that anyone ever sought their help. He considered that, whether or not the idea put forward by Mr. Buckley about the Manchester College of Technology was adopted, the suggestion of Mr. Brearley ought not to be allowed to fall to the ground. With regard to the matter of sulphur content in the coal and purified gas, his experience was that sulphur in purified gas varied. For many years he had averaged 12 grains; and afterwards, when they got up to 27 or 28, they thought they were very high indeed. The circumstances under which this variation took place were certainly not to be foretold from the percentage of sulphur in the coal. The subject was worthy of further research.

Mr. J. W. Bottomley (Milnrow), speaking as one who had charge of a small works, appreciated very much what Mr. Brearley had said in regard to their position, in view of the increased competition of electricity. Had the time come when it should be ascertained definitely, on financial grounds, whether they should take a page out of their competitors' book, and distribute from larger centres? In the Lancashire district, the towns were "hob-nobbing" one on top of the other. No other part of the country, unless it were the West Riding of Yorkshire, was, in his opinion, more favourable for something of that description to be attempted; and he thought that an office with a paid staff, in connection with the Commercial Section, could analyze the working costs of every undertaking within the area, and ascertain, more particularly with regard to smaller undertakings, whether it would not be to the benefit of the industry as a whole if they could supply their gas by high-pressure transmission. Of course, on that suggestion, he had many friends in the industry who said: "You are going to put me out of work." He was also going to put himself out of work. But the cause of the industry came first, and he and his friends second. He had often wondered, when he had known that smaller works were incurring further capital expenditure by increasing the size of their plant, whether they were actually doing the right thing or not; and it could be ascertaind, in his opinion, on the basis of pounds, shillings, and pence. Passing to another thing that affected the small works, he thought they laboured at a disadvantage under the Gas Regulation Act with regard to the number of tests taken of the calorific value of the gas. The larger the undertaking, the more frequent the tests; and it was the average of those tests which determined the calorific value for the period. But if they were in charge of a works of (say) 14 millions, two or three outside tests per quarter was the number specified. This was a disadvantage rather than an advantage, because if only two tests were taken, supposing the man happened to be a little down the first time, he was in fear and trembling, and for the rest of the period he was well above his mark. [Laughter.] That was quite true. This point in the regulations was a big disadvantage to the smaller works.

Mr. W. M. Carr (Stretford) observed that the point of chemical control was one of particular interest in relation to smaller works of about 30 to 40 millions; but when they got up to works of close on 200 millions—or (say) in works of 100 millions upwards—those works ought to be able to afford to have a chemist. They could not, in fact, afford to be without one. He hoped that engineers of such works, however well qualified they might feel themselves to be, would go bravely to their Boards and say that the appointment of a chemist was necessary. He appealed to members in charge of works of any considerable size to weigh-up the importance of this point. In regard to the question of amalgamating the smaller undertakings with the larger plants, there must be many circumstances in which this would pay; but, on the other hand, there would be cases in which it would not pay. It would depend almost entirely on the distance the gas had to be transmitted, and how effectively the small works could be managed. He was prepared to say that the well-managed small works producing 100 million c.ft. of gas could at the present day operate very closely in cost to works producing 700 to 1000 millions. From his experience of works with which he was connected, the saving was not very big as between the 100 million and the 1000 million plant. This, of course, was taking it for granted that the 100 million works had the supervision and management which were essential for the best results to be obtained. It would be interesting to hear from members more about what they were doing in the matter of chemical control in works of from 100 to 200 million c.ft. output.

Mr. James Bridge (Elland) said he was in charge of works making a little over 150 millions a year; and they had a fair amount of chemical supervision in the running of the plant. They had a fairly highly trained chemist, and each day he carried out at least six calorific value determinations of the gas as made and supplied to the town. They received their coal in barges of 60 tons at a time. Each load coming along was tested for the volatile matter and ash content. The retort temperatures were determined each day; and all the other routine tests, such as sulphur in gas and ammonia, were carried out at least once a week.

Mr. F. Elliott (Leyland) said they had no trained chemist at his works. It would have been of great assistance if he had been able to call in such aid at a time when he was making similar tests to those mentioned by Mr. Jennings. Something ought to be done in the matter of chemical control.

Mr. H. W. Kaye (Earby and Thornton) said he had had similar trouble to that spoken of by Mr. Jennings. This occurred at a works in the South of England, where they were using a good South Yorkshire coal. At last he found out that the bother was caused by one man—it was during the period of the war—not drawing the retorts at the proper time, and not taking particular care to see that the doors were sealed. The trouble, however, was not occurring on that workman's shift, but on the next shift. By getting rid of the man, and seeing that the retorts were properly sealed, they brought things back to normal.

Alderman F. J. West (Manchester) said that at his works during the past few years they had analyzed something like 30 or 40 different classes of coal; and if the information they had obtained was of any use to members, he would be glad to supply it. If the Council of the Institution, too, had any particular carbonizing problem before them at any time, if it were within the capacity of his plant he would be very pleased to tackle it.

Vote of Thanks.

Alderman F. J. West (Manchester) moved that the President be accorded a hearty vote of thanks for his occupancy of the chair. He had had an opportunity of presiding at a unique and outstanding meeting of the Institution. They congratulated him also on his starting-out on his second year in the office, and all wished him success in his work during the next twelve months.

Mr. Mottram, seconding, remarked that in Mr. Shapley they had a live President, who would use all his endeavours to look after their interests.

The motion was carried with applause.

The President, returning thanks, said it had been a great pleasure to take part in such a meeting as they had had that day. He felt he must support the remarks of Mr. Carr, who had suggested that works of over 100 million c.ft. capacity should have a fully qualified chemist. As far as they in Leeds were concerned, they were ever willing to assist their smaller neighbours with any special laboratory work they might require.

Mr. Hudson proposed, and Mr. Brearley seconded, a vote of thanks to the officers and Committee for their work during the past year, and particularly to Mr. Rogerson, for his indefatigable labours.

Mr. Rogerson, replying, said the work was a real pleasure to him, for he found nothing but a brotherly feeling throughout the Institution, which made his task a comparatively easy one.

Second Conference on Bituminous Coal.

A second Conference on Bituminous Coal will be held at the Carnegie Institute of Technology (Pittsburg) in November, 1928. Dr. Thomas S. Baker, President of the Institute, says: "We are so greatly encouraged by the success of the first International Conference on Bituminous Coal held at the Carnegie Institue of Technology last year, that we have definitely decided to hold a second and similar international congress two years from now." The first conference was called by Dr. Baker for the purpose of finding new uses for bituminous coal, and especially to discuss the problem of liquefying coal to supplement the petroleum oil supply of the world. More than 1700 delegates, including representatives of thirteen different countries, attended. The speakers included Dr. Frederick Bergius and Prof. Franz Fischer, who have successfully liquefied coal; Dr. C. H. Lander, Mr. Geoffrey M. Gill, Mr. Harald Nielsen, Dr. R. Lessing, and several other well-known foreign scientists, in addition to a long list of prominent American engineers and men of affairs and science. President Baker states that the second conference will be planned to uncover whatever new information is made available during the coming two years regarding various problems in the use of soft coal.

The New Works for Johannesburg.—We learn that the examination by Mr. W. R. Herring, M.Inst.C.E., of the tenders for the new gas-works for the Johannesburg Municipality has resulted in his recommending the tender of the Blane Company, representing West's Gas Improvement Company, of Manchester.

SOCIETY OF CHEMICAL INDUSTRY.

A Joint Meeting of the Yorkshire Section and the Fuel Section of the Society of Chemical Industry was held at the Queen's Hotel, Leeds, on Monday, Feb. 28, when a number of papers dealing with gas, coal, coke, and metallurgical problems were read and discussed. Prof. A. SMITHELLS, C.M.G., F.R.S. (Chairman of the Fuel Section of the Society), presided.

The CHAIRMAN, opening the proceedings, said it was a great pleasure to him to be present at the first joint meeting of the Yorkshire Section and of the Fuel Section of the Society, and he hoped it was the first of many such meetings. The Fuel Section and its officers, he said, would be very happy to do anything they could to contribute to the success of such meetings in the future.

Prof. COBB, introducing a paper of which the following is a short summary, said his interest in the subject had been stimulated by experimental work carried out at the Airedale Foundry of the Kitson Engineering Company, Hunslet, Leeds.

THE INFLUENCE OF ATMOSPHERE AND TEMPERATURE UPON THE SCALING OF STEEL.

Part I.—Scaling by Air, Water Vapour, and Carbon Dioxide.

By C. B. MARSON, Ph.D. (Leeds), M.Sc., A.I.C., and J. W. COBB, C.B.E., B.Sc., F.I.C.

Part II.—Prevention of Scaling by Hydrogen and Carbon Monoxide.

By H. T. ANGUS, Ph.D. (Leeds), M.Sc., and J. W. COBB, C.B.E., B.Sc., F.I.C.

SHORT SUMMARY.

"Scaling" is the term used to denote the formation of a surface layer of oxide when such a metal as iron or steel is heated to a high temperature in an ordinary furnace atmosphere. "Scale" is, then, distinct from "rust," which is the result of atmospheric oxidation of iron or steel at ordinary temperatures.

The technical and financial importance of the phenomenon of scaling arises in the first place from the actual loss of metal incurred which, *in toto*, is enormous. There are other consequences, however, which at times are even more serious, such as the thinning-down by scaling of the thickness of a metal plate, bar, tube, or other structure, to a point which involves its rejection, or the roughening of the surface under the scale to such an extent as to necessitate excessive costs in machining.

The ordinary way of minimizing scaling is to heat in a reducing atmosphere. In the case of a furnace fired directly with coal, this means the emission of smoke; and the pall which hangs over a steel centre such as Sheffield is largely due to this necessity of maintaining an effectively non-oxidizing atmosphere in the heating of metals in its industrial furnaces. If a furnace is fired with ordinary producer gas instead of coal, the reducing atmosphere has still to be maintained, with the emission of smoke, but not in such quantity as comes from the ordinary coal-fired furnace, because the supply of fuel and air to the working hearth of the furnace is more under control.

Plans have been suggested for lessening the actual fuel loss (which is directly consequent upon working with a smoky flame) by admitting a supplementary air supply to the incompletely-burned gases after they have left the hearth. This treatment, if successful, would eliminate smoke and would tend to lessen the fuel loss in the gases leaving the furnace hearth, whether they were used for steam raising or for passing into a regenerator. There is, however, little evidence that such methods have been found of much service in practice. It is, therefore, very desirable to know as exactly as possible what are the conditions that must be satisfied by the fuel burning in the hearth of the furnace if scaling is to be prevented, and with the minimum of smoke emission and fuel loss. It is known, of course, that no free oxygen must be present. Moreover, what is conventionally termed a neutral atmosphere, in which the theoretical air requirement of the fuel has been satisfied, so that the carbon has been completely burned to carbon dioxide and the hydrogen to water vapour, is still capable of oxidizing such a metal as iron. Also, the action will not be independent of the proportions of carbon dioxide and steam, which will be determined by the carbon and hydrogen present in the original fuel as indicated in the following table. The temperature of operation and the composition of the metal are other factors of importance.

Reducing gases of various kinds used in the proper proportion will, no doubt, check the scaling. It is impossible to forecast what degree of control may be obtainable if we only know the relative effectiveness possessed by different varieties of the reducing atmosphere. What is visualized is that, the neutral atmosphere resulting from theoretically complete combustion having been obtained, the anti-scaling constituent may be introduced in regulated amounts so as to secure the desired effect with the minimum smoke emission, fuel wastage, and cost.

It is possible to make some forecast from chemical and equilibria data in the simplest cases; but the importance of time and surface factors, and complications in some of the chemical reactions involved, seemed to make it probable that the best way of obtaining, by laboratory experiment, information applicable in practice would be that of direct trial under chosen conditions.

EXPERIMENTAL METHOD.

With this end in view, the behaviour of a mild boiler-plate steel of known and normal composition was examined, usually at a temperature of 1000° C., when exposed to different atmospheres made up by mixing constituent gases as desired. The amount of scaling over a definite period of time, usually three hours, was determined by direct weighing of the small piece of steel exposed; and any special effect such as that of decarburizing or carburizing was noted by microscopical examination.

As a first step an experimental arrangement was secured by which the increase in weight of the mild steel exposed to a current of nitrogen over three hours was negligible, after which the relative scaling effects of dry air, water vapour, and carbon dioxide, which diminished in the order mentioned, were determined. It was determined, too, how the amount of scale formed diminished as the water vapour in a mixture consisting of 20 p.ct. water vapour and 80 p.ct. nitrogen was gradually replaced by carbon dioxide. These experiments and their results, along with some account of other work bearing on the question, form the subject of Part I., and represent a starting-point as indicating the results obtained in the absence of reducing gases in the furnace atmosphere.

EXPERIMENTS IN PART II.

The next step was to determine how much hydrogen would have to be present in a mixture of hydrogen and steam in order to diminish the scaling effect of the latter to a negligible quantity, and similarly how much carbon monoxide would have to be present in a mixture of carbon monoxide and carbon dioxide to bring about the same result—that is, how far protection could be secured in each case by burning only a portion of the combustible constituent, hydrogen or carbon monoxide. The figures obtained—50 p.ct. of hydrogen in the hydrogen and steam mixture, 58 p.ct. of carbon monoxide in the carbon monoxide and carbon dioxide mixture—indicated that immunity from scaling by this simple and direct method was only to be obtained by leaving a large proportion of the combustible gas unburned, and so incurring a heavy fuel loss.

The same conclusion can be drawn from similar experiments made with mixtures of hydrogen and carbon dioxide on the one hand, and carbon monoxide and water vapour on the other.

The hydrogen and carbon dioxide mixture was a little more complicated in its behaviour than the others. As hydrogen is added to water vapour, the scaling effect is steadily diminished until it ceases altogether; but when hydrogen is added to carbon dioxide in gradually increasing quantities, the influence of the first additions of hydrogen is to increase the scaling effect, because of the water vapour generated by the interaction of hydrogen and carbon dioxide at 1000° C., which would, so far as time and other conditions permitted, proceed to a composition corresponding with the water-gas equilibrium at that temperature. A maximum scaling effect was obtained when the hydrogen initially present in the hydrogen-carbon dioxide mixture was 26 p.ct., after which it fell away. These experiments form the subject of Part II.

Fuel Composition, Volume P.Ct.							Composition of Products of Combustion. Volume P.Ct.		
Description.	CO_2.	CO.	C_nH_m.	CH_4.	H_2.	N_2.	CO_2.	H_2O.	N_2.
Coal gas	3·0	14·0	2·0	23·5	49·5	8·0	9·2	20·2	70·6
Producer gas	3·8	27·2	..	3·1	9·7	56·2	14·9	6·9	78·2
Mond gas	16·0	11·0	..	3·0	27·0	43·0	14·6	16·0	69·4
Blue water gas	4·5	40·7	..	0·6	49·3	4·9	16·0	17·7	66·3
Blast furnace gas	12·0	26·4	..	..	1·5	60·1	24·6	1·0	74·4

Fuel Composition, Weight P.Ct.							
—	C.	H_2.	N_2.	O_2.			
Bituminous coal (dry basis)	82·1	4·7	..	7·1	17·0	5·8	77·2
Vertical retort tar	85·6	7·3	1·7	5·4	15·5	7·9	76·6
Anglo-American fuel oil	86·2	12·7	1·1	..	13·1	11·5	75·4

FURTHER WORK IN HAND.

Work is now proceeding in the direction of ascertaining the anti-scaling effect obtainable by the introduction of reducing agents other than hydrogen and carbon monoxide. The results obtained will be given, it is hoped, as Part III. of the paper at a future date. It may be said, however, that a start has been made by the addition of gradually increasing quantities of methane to a neutral atmosphere consisting of nitrogen with 10 p.ct. of carbon dioxide and 10 p.ct. of steam. It has been found that approximately 30 p.ct. of methane had to be present

before scaling was entirely prevented. Though the percentage of methane was raised to 66 p.ct., and carbon deposition then occurred freely in the tube, the surface of the iron was not carburized. In another experiment, however, when exposure was made to a gas mixture consisting of 90 p.ct. of methane and 10 p.ct. of nitrogen, carburizing was noticed; cementite and pearlite having formed on the surface of the steel. The action of methane is being further examined.

The great increase in the rate of oxidation observed at 1000° as compared with 900° C., and other considerations, make it important to extend this work to higher temperatures, such as are attained, for example, in welding and steel making.

The work will doubtless indicate practicable methods of preventing scaling altogether, and may facilitate the choice of fuels for particular industrial operations.

Conclusions, Part I.

Samples of mild steel were heated for 3 hours in different atmospheres of water vapour and carbon dioxide, at temperatures of 900° and 1000° C. The resulting increase in weight was taken as a measure of the oxidizing effect of the atmosphere used. These experiments showed that:

(1) At temperatures of 900° and 1000° mild steel does not scale in nitrogen.

(2) The scaling effect of carbon dioxide is definite, but relatively small. After 3 hours' heating at 900°, the increase in weight was 0·0016 gramme per sq.cm. (0·05 oz. per sq.ft.) and at 1000° was 0·0064 gramme per sq.cm. (0·21 oz. per sq.ft.).

(3) Water vapour has a more marked effect. At 900°, in an atmosphere of 80 p.ct. nitrogen and 20 p.ct. water vapour, the increase in weight was 0·007 gramme per sq.cm. (0·23 oz. per sq.ft.), and at 1000° was 0·0166 gramme per sq.cm. (0·54 oz. per sq.ft.). Replacement of this water vapour by carbon dioxide reduced the amount of scale formed, as the following table shows:

Atmosphere. Composition P.Ct.			Increase in Weight. Gramme per Sq.Cm.	
N_2.	H_2O.	CO_2.	900° C.	1000° C.
80	20	0	0·0070	0·0166
80	15	5	0·0067	0·0128
80	10	10	0·0039	0·0111
80	5	15	0·0037	0 0095
80	0	20	0·0005	0·0024

(4) Dry air causes rapid scaling to take place at these temperatures. At 900° and 1000° the increases in weight were 0·0295 gramme per sq.cm. (0·97 oz. per sq.ft.) and 0·0635 gramme per sq.cm. (2·08 oz. per sq.ft.) respectively.

(5) The great increase in scaling by air, water vapour, and carbon dioxide between 900° and 1000° indicates the advisability of measurements at higher temperatures.

(6) The chemical composition of scale varies according to the composition and temperature of the scaling atmosphere.

Summary, Part II.

1. In atmospheres consisting entirely of carbon monoxide and carbon dioxide, 58 p.ct. of carbon monoxide is necessary to prevent oxidation entirely at 1000°, but 20 p.ct. of carbon monoxide reduces scaling to one-half of the amount caused by pure carbon dioxide.

2. 50 p.ct. of hydrogen will prevent scaling in an atmosphere of hydrogen and steam.

3. The addition of hydrogen to carbon dioxide produces by decomposition at 1000° an atmosphere containing water vapour which is much more reactive than pure carbon dioxide. The maximum scaling effect occurred with an initial mixture of 26 p.ct. of hydrogen and 74 p.ct. of carbon dioxide, when scaling was three-and-a-half times as great as with pure carbon dioxide. When 57 p.ct. of hydrogen was initially present, no scaling occurred.

4. The gradual addition of carbon monoxide to steam caused a continual decrease in the weight of scale formed, until oxidation ceased with the addition of about 80 p.ct. of carbon monoxide.

[The discussion which followed the reading of this paper, though of great importance to steel manufacturers, is too wide of the interests of the gas industry to be published here.]

A THERMAL STUDY OF THE PROCESS OF MANUFACTURE OF WATER GAS.

By A. Parker, D.Sc., F.I.C., M.I.Chem.E., Research Chemist to the Joint Committee of the University of Leeds and the Institution of Gas Engineers.

The manufacture of water gas first became an industrial proposition in 1873 with the introduction of the intermittent system by Strong and by Lowe in America. Strong, who aimed at manufacturing blue water gas mainly for heating purposes, utilized the heat value of the blow gases to superheat the steam admitted to the generator. Lowe, on the other hand, aimed at producing a gas of high illuminating value, and utilized the large quantities of combustible gas produced during the blow periods for heating chambers in which enriching oil was decomposed. No real progress in the manufacture of water gas in this country was made until 1888, when a plant was installed at the Leeds Forge. Since that time the utilization of water gas has advanced rapidly, and the manufacture of water gas, both blue and carburetted, is now an important auxiliary in the production of gas for town supply.

The blue water gas process, according to general British practice, may conveniently be divided into two distinct operations. The hot fuel, usually coke, is first raised to a high temperature by the admission of air at such velocity that the pressure below the generator grate is twelve to eighteen inches water gauge. This operation, known as the "blow," occupies from one to three minutes. The gases produced are blown away to the atmosphere through the stack, either directly or after combination with air and passage through a waste-heat boiler. When the temperature of the coke has been raised to the required degree, the air supply is closed, and the bed of fuel is submitted to the action of steam supplied at a measured rate. The steaming operation, which is known as the "run," occupies from four to ten minutes according to the cycle of operations adopted. The blow and run operations are carried out alternately during a period of several hours, at the end of which the operations are suspended for the removal of clinker and ashes, unless mechanical grates are provided.

Blow Period.

The addition of heat to the bed of fuel during the blow period results mainly from that developed by the oxidation of carbon to carbon monoxide and carbon dioxide; and provided other conditions remain unchanged, the degree of heat addition would be dependent on the proportion in which these two gases are produced. The principal reactions which take place may be represented by the equations:

$$(1)\ C + O_2 = CO_2 + 97\ \text{kg.-cal.}^*$$
$$(2)\ C + \tfrac{1}{2}O_2 = CO + 29\ \text{kg.-cal}^*$$

The aim during the air-blow should, therefore, be to obtain the maximum amount of carbon dioxide and the minimum of carbon monoxide. The first reaction predominates at lower temperatures, and the second at higher temperatures. The efficiency of heat generation, therefore, decreases with rise of temperature.

Run Period.

When steam is passed over incandescent coke, of the reactions which occur those represented by equations (3) and (4) are thermally the most important.

$$(3)\ C + H_2O = CO + H_2 - 29\ \text{kg-cal.}$$
$$(4)\ C + 2H_2O = CO_2 + 2H_2 - 19\ \text{kg.-cal.}$$

At temperatures above 1000° C. the products of reaction of steam and carbon are almost entirely carbon monoxide and hydrogen. At lower temperatures the importance of reaction (4) increases and the proportion of steam decomposed decreases.

From consideration of the reactions which take place in the intermittent process of manufacture of water gas, it is clear that, in order to obtain high efficiency of heat addition during the air-blow, the fuel must be kept at a comparatively low temperature, and the time of contact of the gases with the hot fuel must be small. On the other hand, to obtain a high efficiency during the steaming operation, the fuel should be maintained at a high temperature, and a longer time of contact must be allowed. It is evident, therefore, that these opposing factors must be taken into account in determining the conditions of best efficiency for the whole process.

In the manufacture of water gas by the intermittent process, the amount of heat added to the bed of fuel during the blow periods must be sufficient exactly to balance the sum of the quantity of heat taken from the fuel during the run periods, the heat lost by radiation and convection, and the heat taken from the bed of fuel during the operation of clinkering. It should thus be possible to ascertain the particular conditions of blow and run periods which, when combined, would give the best over-all efficiency for the whole process, provided that the necessary data could be obtained with the required accuracy from experiments conducted separately on blow and run processes under different conditions. With this object in view, Strache and Jahoda carried out a number of experiments, the results of which are given in a series of papers (J. Gasbeleucht., 1900 and 1904) abstracted in the "Gas Journal." From the results of their experiments, carried out separately on the blow and run periods, Strache and Jahoda endeavoured to predict the conditions of operation which should yield the best efficiency for the whole process. The difficulties encountered in experiments of this type, however, are so great that it is doubtful whether the

* The figures given to represent the heats of formation of carbon dioxide and carbon monoxide are based on the assumption that the heat of combustion of coke carbon is the same as that usually accepted for so-called amorphous carbon. If coke carbon be considered to possess the same thermal value as graphite, then the heat evolutions corresponding with equations (1) and (2) would be 95 kg.-cal. and 27 kg.-cal. respectively, and the amounts of heat absorbed during reactions (3) and (4) would be 31 kg.-cal. and 21 kg.-cal.

conclusions drawn by these investigators can be accepted with confidence.

RECENT INVESTIGATIONS.

During recent years the large-scale production of water gas has been the subject of independent investigations by the Joint Committee of the University of Leeds and the Institution of Gas Engineers,* and by the Fuel Research Board.† From the data procured, thermal balances were constructed. As an example of a thermal balance under conditions typical of British practice, the following is taken from the Tenth Report of the Research Committee of the Institution of Gas Engineers:

TABLE I.—*Heat Balance in Therms per 1000 C.Ft of Water Gas Made.*

Heat supplied:	
(*a*) Coke to generator	4·900
(*b*) Steam to generator (total heat)	0·386
(*c*) Sensible heat of air to blower	− 0 001
	5·285
Accounted for as follows:	
(1) Water gas, potential heat	2·960
(2) ,, sensible heat	0·171
(3) Steam not decomposed (total heat)	0 163
(4) Blow gas, potential heat	1·042
(5) ,, sensible heat	0·462
(6) Ashes, clinker, and dust, potential heat	0·294
(7) ,, ,, ,, ,, sensible heat	0·020
(8) Losses not separately determined, leakages, radiation, convection, &c. (difference)	0·173
	5·285

In the balance given in Table I. three sources of heat are considered: (*a*) Potential and sensible heat of the fuel supplied to the generator; (*b*) total heat—*i.e.*, sensible heat *plus* latent heat, of the steam supplied during the run periods; (*c*) sensible heat of the air supplied during the blow periods at the temperature at which it entered the blower.

The expenditure of the total heat in the three items is accounted for in eight items: (1) Potential heat value of the water gas made; (2) sensible heat of water gas at the temperature at which it left the generator; (3) total heat of undecomposed steam at the outlet of the generator; (4) potential heat of blow gas; (5) sensible heat of blow gas at outlet generator (this item including the total heat of the water vapour resulting from the evaporation of moisture in the coke charged into the generator); (6) potential heat value of the ashes and clinker removed from the generator during clinkering operations, and of the coke dust caught in the dust catch pocket of the plant; (7) sensible heat of the ashes, clinker, and dust, on the assumption that they were removed from the generator at 800°; (8) the balance, or difference item, which includes losses by radiation and convection not separately determined, and the algebraic summation of experimental errors and errors of assumptions.

In the calculation of the various items, the values of the heat capacities used were those given in the Appendix to the Fourth Report of the Research Committee of the Institution of Gas Engineers. It should be noted that throughout the items in Table I. the calorific values were taken at ordinary temperature (15·5°), and that the figures for amounts of sensible heat represent the differences of the heat contents at ordinary temperature and the temperature of the substances under consideration.

The quantities required in the evaluation of items (*a*), (*b*), (1), (2), (3), (6), and (7) were measured. The volumes of air and blow gas, however, required for items (*c*), (4), and (5) were obtained indirectly in the following manner. A carbon account, Table II., was drawn up from the results of analyses for the amounts of this element in the coke supplied to the generator, the water gas made, the ashes, clinker, and dust withdrawn, and the blow gas produced.

TABLE II.—*Carbon Account.*

Lbs. per 1000 C.Ft. of Water Gas Made.

Coke supplied to generator	31·87
Water gas made	14·29
Ashes, clinker, and dust	1·95
Blow gas (difference)	15·63
	31·87

The amount of carbon in the blow gas produced was taken as the difference between the weight in the coke supplied to the generator and the total of the weights accounted for in the other items. In reference to this procedure for obtaining the amount of carbon in the blow gas, the following statement appears in both the Sixth and Tenth Reports of the Research Committee of the Institution of Gas Engineers.

> This method of calculation of the carbon in the blow gas is not strictly accurate, since it includes a certain amount of solid carbon which was carried forward up the stack by the blow gas and into the scrubber by the water gas; but it appeared to be the only method of calculation available, and in any case the results should be sufficiently accurate for the purpose of the tests.

* Sixth, Seventh, and Tenth Reports of the Research Committee of the Institution of Gas Engineers, Trans. Inst. Gas Eng., 1921, 1922, and 1923.

† "Comparisons of Some Methods of Running Water Gas Plant," King and Shaw, Fuel Research Board, Technical Paper No. 6, 1923.

From the weight of carbon taken as consumed during the blow periods and the compositions of the gases which passed up the stack, the volumes of blow gas produced and air supplied per 1000 c.ft. of water gas made in the test quoted were found by calculation to have been 1913 c.ft. and 1722 c.ft. respectively. The same method of estimation of the volumes of blow gas and air was adopted in similar investigations conducted by the Fuel Research Board.

The statement quoted from the Reports of the Research Committee of the Institution of Gas Engineers makes it clear that the investigators were fully aware of the sources of error in the method adopted for determining the volumes of blow gas. It was also realized that losses of carbon occur by combustion during the operations of clinkering. The ideal would be to make accurate direct measurements of the air supplied to the generator; but this is not easy of achievement with the intermittent flows and changing pressures obtaining in the manufacture of water gas. Measurement by means of Pitot tubes was given consideration, but was rejected as being less satisfactory for the particular purpose than the method adopted.

DR. TRAVERS' CRITICISM.

In a criticism of the method of analysis of the water gas process by the construction of thermal accounts of the type given in Table I., M. W. Travers* states that, since items (4) and (5) were calculated from the difference item of a carbon balance, a balance should be obtained without the inclusion of item (8), which should therefore appear under the heading "arithmetical errors." The author desires to state that item (8) does not result from errors of arithmetic, but represents the sum of losses by radiation, convection, and leakages not separately determined, and the algebraical summation of unavoidable experimental errors and errors, already mentioned, involved in the derivation of items (4) and (5).

In recent publications on this subject, Travers† expresses the opinion that in studying the results of tests of water-gas plant, separate thermal accounts for the blow and run processes form a useful criterion of the accuracy of the tests. With this opinion the present author is in full agreement, provided the whole of the fundamental data used in the construction of the separate accounts is known with sufficient accuracy.

By utilizing the results of Test D of the Tenth Report of the Research Committee of the Institution of Gas Engineers, from which results Table I. has been constructed, Travers compiled separate thermal accounts, reproduced in Table III., for the blow and run processes. The figures in this table represent the heat changes, in pound-Centigrade heat units, which occurred per ton of coke supplied to the generator.

It may be seen from the figures given in Table III. that, according to Travers, the quantity of heat added to the bed of fuel during the blow periods, 3,147,500 C.H.U., exceeded the quantity removed during the run periods, 2,834,150 C.H.U., by 313,350 C.H.U., or approximately 10 p.ct. As a result of further calculations, the same author concluded that this discrepancy could be explained by assuming that about 5 p.ct. of the carbon, taken as gasified in the production of blow gas, was lost, and that the gases left the fuel bed at temperatures about 50° higher than those recorded by the pyrometers.

TABLE III.—*Thermal Accounts in C H.U. per Ton of Coke*

	Blow.	Run.
Heat of reaction	+ 4,315,950	− 2,011,350
Sensible heat—		
Gas	− 1,106,650	− 702,350
Air	+ 27,150	..
Steam	..	+ 145,950
Coke	+ 4,600	+ 4,150
Ashes	− 33,550	− 30,550
Radiation, &c.	− 60,000	− 240,000
Total	+ 3,147,500	− 2,834,150

It has already been mentioned that the investigators who carried out the tests for the Institution of Gas Engineers were aware that solid carbon was carried forward by the blow gas and water gas, and that further unmeasured losses occurred during the operations of clinkering; but with the precautions taken in the test to which Tables I., II., and III. refer, it is unlikely that the temperatures recorded were in error to the extent of 50°. The papers by Travers have therefore been studied; and of the points of importance noted, attention is drawn to the following:

I. The basic data used in the construction of the accounts given in Table III. included:

$$(a)\ C + 2H_2O = CO_2 + 2H_2 - 20{,}900\ C\ H\ U.$$
$$(b)\ C + H_2O = CO + H_2 - 31{,}000\ C.H.U$$

These equations refer to graphitic carbon. The thermal properties of coke carbon are not accurately known, but if coke carbon possesses the same thermal properties as so-called amorphous carbon, then the heat changes for the two equations

* "GAS JOURNAL," 1925, **172**, 500.

† Trans. Inst. Chem. Eng., 1924, **2**, 65; also J.S.C.I., 1924, **43**, 355 T.

should be (*a*)—19,000 and (*b*)—29,000, which figures differ from those used by 10 p.ct. and 7 p.ct. respectively.

II. No account was taken of the heat expended by the blow gases in evaporating moisture from the coke as charged into the generator. The moisture in the coke supplied was 10·8 p.ct., and correction for this item would reduce the discrepancy in Table III. from 0·31335 million C.H.U. to approximately 0·09 million units, or from 10 p.ct. to 3 p.ct.

III. The gaseous hydrogen which may be derived from the amount of this element in the coke as supplied does not appear to have been considered. The manner in which this hydrogen is gasified cannot be decided from present knowledge of the subject, but it probably affects both the heat added during the blow periods and that abstracted during the run periods by approximately 0·24 million C.H.U.

Uncertainties of Data.

The points raised demonstrate that the uncertainties existing in connection with the basic data and methods employed in the construction of Table III. are as large as the discrepancy in the totals of the separate thermal accounts for the blow and run periods.

An attempt to check Table III. by recalculation, using the same fundamental data as employed by Travers, gave the very different results shown in Table IV. The difference in the figures for the sensible heat of the blow gas is partly accounted for by the inclusion, in the figure in Table IV., of the amount of heat (221,000 C.H.U.) used in the evaporation of water from the coke as supplied to the generator. The sensible heat of the blow gas alone, as recalculated, is 1,264,430 C.H.U., as against 1,106,650 C.H.U. given in Table III. The differences in the figures for sensible heat values of the coke would appear mainly to result from neglect to take into account in Table III. the water content of the coke supplied to the generator.

The differences in the two tables are of considerable importance, for it will be observed that in Table IV. the discrepancy in the totals is only 7800 C.H.U., or 0·3 p.ct., which is well within experimental error, as against 313,350 C.H.U., or 10 p.ct., in Table III.

Table IV.—*Thermal Account in C.H.U. per Ton of Coke.*

—	Blow.	Run.
Heat of reaction	+ 4,367,510	− 1,971,190
Sensible heat—		
Gas	− 1,485,430	− 688,180
Air	+ 24,090	..
Steam	..	+ 92,850
Coke	+ 7,390	+ 6,760
Ashes	− 32,200	− 29,400
Radiation, &c.	− 60,000	− 240,000
Total	+ 2,821,360	− 2,829,160

The author does not wish it to be concluded, since good agreement is shown in Table IV., that no losses of carbon occurred. Simple observation of the operation of a water gas plant is sufficient clearly to show that losses of carbon do occur. The close agreement in Table IV. probably results from errors of assumption in the fundamental thermal data employed.

It is possible to construct separate thermal accounts for the blow and run periods without making any assumptions regarding the thermal properties of coke carbon. A thermal account, dependent on the determined calorific value of coke and not on assumptions regarding coke carbon, as constructed by the author for the run periods of the test to which the previous tables refer, is given in Table V.

The figures given in Table V. have been obtained by the following methods:

1. The carbon content of 1000 c.ft. of blue water gas was 14·29 lbs., and the percentage of carbon in the coke (moisture-free) supplied to the generator was 82·1, so that the weight of dry coke converted into 1000 c.ft. of blue water gas was 14·29 × 100 ÷ 82·1 lbs. = 17·406 lbs.

The determined calorific value of the dry coke was 12,620 B.Th.U. per lb.; therefore the heat value of 17·406 lbs. is 17·406 × 12,620 ÷ 100,000 = 2·197 therms.

2. The total heat value of the steam supplied is taken from item (*b*) of Table I.

4. The potential heat value of 1000 c.ft. of blue water gas was obtained from the determined calorific value, and is the same as item (1) Table I.

5. The volume of hydrogen sulphide produced per 1000 c.ft. of purified water gas made was 3·3 c.ft., and the calorific value used in the calculation of this item was 136,000 g.-cal. per g.-mol.

6 and 7. These figures have been taken from Table I., items (2) and (3).

8. The heat lost by radiation, &c., has been assumed to be 2 p.ct. of the heat value of the total fuel supplied to the generator; and this is equivalent to 0·069 therm for the time occupied during run periods in the production of 1000 c.ft. of blue water gas.

Table V.—*Run Periods.*

Therms per 1000 C.Ft. of Blue Water Gas Made.

Heat supplied—	
1. Coke	2·197
2. Steam (total heat)	0·386
3. Total	2·583
Heat removed—	
4. Water gas, potential heat	2·960
5. H_2S, potential heat	0·021
6. Water gas, sensible heat	0·171
7. Steam not decomposed (total heat)	0·163
8. Radiation, &c.	0·069
9. Total	3·384

10. Net heat removed from bed of fuel = 3·384 − 2·583 = 0·801 therm.

The thermal account in Table V. shows that during the run period the production of 1000 c.ft. of water gas was accompanied by a net removal of 0·801 therm from the bed of fuel. In order to obtain a true balance, the same amount of heat must have been added to the bed of fuel during the corresponding blow periods. Let x lb. represent the weight of coke consumed for this purpose. It is then possible to construct the thermal account given in Table VI. for the blow periods.

Table VI.—*Blow Periods.*

Therms per 1000 C.Ft. of Blue Water Gas Made.

Heat supplied—	
1. Coke	0·126x
2. Air	− 0·001
3. Total	0·126x − 0·001
Heat removed—	
4. Blow gas, potential heat	0·055x
5. ,, sensible heat	0·021x
6. Water vapour, total heat	0·069
7. Ashes, clinker, dust, sensible heat	0·020
8. Radiation, &c.	0·022
9. Total	0·076x + 0·111

10. Net heat added to bed of fuel = 0·050x − 0·112.

The figures given in Table VI. were obtained by the following methods:

1. The determined calorific value of the coke used was 12,620 B.Th.U., or 0·126 therm per lb.

2. This figure is taken from item (2) of Table I.

4. The potential heat value of the blow gas from 15·63 lbs. of carbon (Table II.)—*i.e.*, from 19·04 lbs. of coke—was 1·042 therms (Table I.); therefore the potential heat of the blow gas from x lb. of coke was 0·055x therm.

5. The sensible heat of the blow gas from 19·04 lbs. of coke was 0·392 therm, so that the sensible heat of the gas from x lbs. of coke was 0·021x therm.

6. The total heat of the water vapour removed from the coke was 0·069 therm.

7. It has been assumed that during the operations of clinkering a balance was obtained, except for the sensible heat of the ashes, clinker, and dust removed (item 7, Table I.), which heat would thus require to be replaced during blow periods. The validity of this assumption could only be ascertained by separate experimental determinations of the heat changes during clinkering operations.

8. The figure for heat loss by radiation, &c., was obtained in the same manner as item 8, Table V.

By equating items 10 of Table V. and VI.—

0·050x = 0·913; therefore x = 18·26 lbs. of coke, which contained 14·99 lbs. of carbon.

The weight of carbon consumed during the blow periods, as given by the difference item of the carbon balance, Table II., was 15·63 lbs., so that, according to the deduction from Tables V. and VI., the loss of carbon was 0·64 lb. per 1000 c.ft. of water gas made, or 2 p.ct. of the total carbon supplied, 31·87 lbs., Table II. This figure for carbon loss is within experimental error, for the determination of the calorific value of the water gas made, which is only one item, may have been in error to the extent of 1 p.ct. This means that item 4 of Table V. may be 2·93 or 2·99. If it were 2·99, then the value of x would be 18·86 lbs. of coke containing 15·48 lbs. of carbon, leaving only 0·15 lb. of carbon, or 0·5 p.ct., to be accounted for by loss.

It may thus be concluded that, until tests including definite measurements of the heat changes during clinkering periods, in addition to the measurements made in the tests by the Research Committee of the Institution of Gas Engineers, have been carried out, thermal accounts of the type given in Table I. seem to represent the most practicable means of making a useful analysis. When the heat changes during clinkering have also been ascertained by experiment, then separate balances for the blow and run periods compiled on the principles adopted in the construction of Tables V. and VI. would constitute a further useful criterion of accuracy. Separate balances requiring a knowledge of the thermal properties of coke carbon cannot be

considered to be of value until accurate thermal data regarding coke carbon have been experimentally determined.

Discussion.

Dr. J. G. KING (H.M. Fuel Research Station, Greenwich) said that the problem Dr. Parker had attacked was one which had required attention for some considerable time. The usual scientific method of making a heat balance of a water gas plant had been to add up the separate items; but this left unaccounted-for the heat radiated from the setting, and the unknown loss in the blow gases. Dr. Travers, in his calculations, had made an assumption for the heat radiated from the setting. In settings of different types, however, this was bound to vary; and it was almost impossible to add this assumed quantity to actual measured quantities. In experiments carried out at the Fuel Research Station, the volume of blow gases had actually been measured by Pitot tubes, and it had also been calculated. The results with Pitot tubes were not published, however, because the investigators were not satisfied with them. The only other method was to use a holder; but this they had not attempted yet. Dr. Parker, by applying corrections to Dr. Travers' results, had got the difference down to within 2 p.ct. At the Fuel Research Station they had carried out experiments on rather different lines, and had tried to measure the losses of carbon. For example, when the generator was being clinkered, carbon escaped up the stack, which quantity they had measured. They had also ascertained the amount taken out in the clinker, and burned as the clinker lay on the ground, and that carried forward as dust with the water gas. Adding those losses up, they had found that they were less than 1 p.ct. of the total carbon added to the generator. Taking this in conjunction with the fact that the experimental error was of the order of 1 p.ct., it was in line with Dr. Parker's results. Later on, a system such as Dr. Travers had suggested ought to be worked out, with all the various losses of carbon from the system added. They would still be faced, however, with the difficulty of measuring radiation losses. They could not make the water gas generator an exact calorimeter; and it seemed that the method of measuring the small carbon losses, and adding them in, was perhaps the better way. He hoped Dr. Parker would continue his work. The Fuel Research Station staff had carried out some work in this connection, and would try to add something to Dr. Travers' results.

Dr. M. W. TRAVERS, in a written communication, expressed doubt as to the reliability of the data generally accepted in work of this kind. From the outset he had been curious to investigate the origins of accepted data before accepting them himself; and he admitted that he had spent a good deal of time in unfruitful investigation. Searching for information as to the specific heat of coke had brought nothing but confusing results. Why this was so was now clear from the work of Schlapfer and Debrunn, published two years ago. All the early work on the subject had been inaccurate. Study of the work of J. Thomsen and Berthelot on the heat of combustion of carbon monoxide left him with the feeling that until this work had been repeated there must remain doubt as to the accuracy of results involving this constant. The mean values of the results of the two series of experiments by J. Thomsen were wonderfully concordant, but anyone who studied the values of individual experiments was likely to receive a shock. The value to be assigned to the heat of combustion of the carbon in coke was really not a matter for speculation at all, and he could not see why it had been supposed to be in any sense a mystery. The only problem was, What were they to call coke? It had been the custom among engineers to adopt a figure which someone in the prehistoric past had assigned to the heat of combustion of charcoal; and as far as engineers were concerned, the validity of this makeshift was probably a matter of no importance. However, in his opinion there was nothing less like charcoal than coke, and particularly high-temperature coke. He had not been interested in coke for very long before he had come to the conclusion that to accept the tradition of the engineers was bad technology and worse chemistry. For many years chemists had been making analyses and determining the calorific values of samples of coke; and it seemed to him that it was not altogether an impossible task, or even a difficult one, to investigate some of these results, with a view to throwing light on the matter. In whatever condition the carbon, sulphur, and hydrogen were present in coke, he considered it fair to assume, supposing that the coke had not been weathered, that they were present in such condition that the heat of decomposition of any compounds might be neglected. The sulphur might be partly present as sulphide, and the ash would undoubtedly contain ferrous oxide. This would oxidize exothermically, so that if any error were so introduced it would make the heat of combustion of carbon too high. In the process of determining the calorific value of the coke, the hydrogen burned to water in the bomb, and one could calculate the heat of combustion from the gross calorific value, 68,380 C.H.U. per 2·015 lbs. of hydrogen at 15° C. This was the value assigned to the constant by Roth after a review of all the work on the subject. (Dr. Travers assumed that the calorimetric results he made use of had been carried out at the air temperature, and that the results were gross values.) It could be assumed that the sulphur was converted into dilute sulphuric acid in the apparatus, and that the heat of combustion was 142,400 C.H.U. for 32 lbs. of sulphur. He had used the values for the total sulphur in the coke, because, if it was unweathered, it was mainly present as carbon compounds and sulphides.

He gave a table showing the results of his investigation of the figures obtained by various chemists. This gave details of the analysis of the samples of coke, the experimental value of the heat of combustion of the coke in B.Th.U. per lb., and the derived value of the heat of combustion of the carbon in the coke in C.H.U. per 12 lbs. The data fell into three categories. The results in the first category were from technical paper No. 6 of H.M. Fuel Research Board, entitled "Comparison of Some Methods of Running Water Gas Plants," and the coke used was from a Durham coal carbonized in horizontal retorts. There were four results given, and the mean of the four results gave the derived value of the heat of combustion of the carbon in the coke in C.H.U. per 12 lbs. as 94,100. He was inclined to feel that there was a misprint in regard to one of these, however, so that he had taken the mean of the remaining three, which was 95,300. This was a possible value for a horizontal retort coke carbon, possibly on the high side.

The next series was more important, being obtained from the paper embodying the results obtained by steaming vertical retorts during the years 1920-21. They represented results for typical modern high-temperature coke. The mean value derived from the whole series was 94,600. This, however, included two rather doubtful results; and if these were eliminated, the mean value became 94,750—a value which he had adopted for use in general investigations involving the use of modern high-temperature coke. The difference was not large.

In the next series of results, taken from Technical Paper No. 8 of the Fuel Research Board, the values were consistently higher than those in the preceding series; the mean being 96,200. A study of the original papers showed that the results were obtained by steaming Wigan Arley coal; and while the average temperature of the combustion chambers in the previous series was about 1250° C., the average temperature in the Wigan Arley series was only 1170° C. This probably meant that the coke was never heated to a temperature of much over 1000° C. Under this condition one would expect that graphitization would be slow.

The results led to the conclusion which was to be expected. In modern high-temperature practice, in which the combustion chamber temperatures exceeded 1300° C., one would expect the carbon in the coke to have a calorific value approaching that found by Roth for graphite—namely, 94,270. The value actually obtained from the second series of results—namely, 94,750—tended towards this value, and was the one which he (Dr. Travers) adopted in the calculations relating to water gas practice. Coke from horizontal retorts would not be expected to be so highly graphitized, but though he suggested that the mean of the first series was a reasonable value, individual results were too few, and insufficiently concordant, to make it possible to draw definite conclusions from them. One would certainly expect the coke in the third series to be markedly less graphitized than that in the second. Obviously, no value for the heat of combustion of carbon in coke could be of universal application; but in attacking any problem generally one must make certain assumptions in accordance with what approached standard practice. However, in the case of coke certain facts tended to simplify the problem. They could actually determine the value of the heat of combustion of the carbon from the calorific value and the analysis of the material. Then in most cases they could entirely ignore the presence of the hydrogen and the sulphur. These would probably be driven off far above the reaction zone, and in the region which was fairly ash-free, and in which the CO_2-CO reaction and the water gas reaction appeared to be frozen. Their presence would have only an infinitesimal effect on the sensible heat of the waste gases. Treating the subject in this way, they could obtain all the information about any particular kind of coke that was required for the compilation of thermal balance-sheets. In conclusion, he pointed out, regretfully, that the higher the temperature at which gas-works coke was produced, the lower—and materially so—was the calorific value of the carbon contained in it.

The CHAIRMAN, as one who had been Chairman of the Committee under whose auspices the work described in the paper was carried out, confessed that he was full of admiration for the patience, ingenuity, and hard work which had been put into the solving of a problem which really needed solving. The production of reliable heat balances for these industrial heat processes was of first importance; and they all wished Dr. Parker success in the further prosecution of his work.

Dr. PARKER, replying to the discussion, said he was interested to hear what was being done at the Fuel Research Station, and would certainly discuss the details with Dr. King, especially the methods of measuring carbon losses. The experience with Pitot tubes at the Fuel Research Station was in accordance with his own anticipations. He wanted to make it clear that he did not in the least belittle the method of constructing separate blow and run balances. The main point was that, in making balances of this kind, it was necessary that the fundamental data should be known with sufficient accuracy. Therefore, he had put forward the new method, which depended on the determined calorific value of coke, and not on the assumed thermal value of coke carbon. In making the calorific value determinations, it must be remembered that coke contained oxygen, hydrogen, sulphur, and nitrogen. There was some doubt as to the method of combination of these elements in the coke; and this doubt must be removed in order to obtain figures of some reliability. An error of 1 p.ct. in the determination of the calorific value of coke carbon would result in errors of 3 and 5 p.ct. in the values of the heat absorbed in the steam-carbon reaction.

A STUDY OF COKE FORMATION.

By R. A. MOTT, M.Sc.

[EXTRACT.]

The most important examples of industrial coke formation occur in the manufacture of metallurgical coke in bye-product or beehive coke ovens, and in the manufacture of town gas in horizontal or vertical retorts. In vertical-retort practice nut coal is preferred; in horizontal-retort practice coal of less than 2 in. size is used; while in coking practice the coal charged to the ovens is usually less than ¼ in. size, and, in some cases, the coal may even be ground through $\frac{1}{16}$ in. mesh. It follows that coke formation from lump coal and from crushed fine coal require separate consideration.

In coke formation from lump coal, the residue often bears some resemblance to the shape of the original coal, though, by swelling, the edges are usually rounded and the residue remaining from large individual pieces of coal may partly coalesce.

In coke formation from crushed fine coal, the coal particles are bound together to form a coherent residue in which, in most cases, the shape of the original coal particles is lost. In addition to the formation of a porous, coherent residue from the individual coal particles, the coalescence of individual particles into an aggregate also occurs. If a piece of partly-formed coke be removed from a coke oven, it may be observed that there are at least three distinct stages in the formation of coke, which are apparent as three vertical bands in the cross-section of an oven (cf. Schmidt, "Fuel," 1926, 5, 489).

In such a piece the central band is the "plastic layer" which, in the cool product, is light and glistening and exhibits large pore spaces. On the side of this layer remote from the source of heat, particles of coal retaining their original shape, but loosely bound together and strongly attached to the plastic layer, may be seen. On the other side of the central band is a layer of fully-formed coke much duller in appearance and less porous than the plastic layer itself. Though the loosely-bound coal particles have the appearance of unaltered coal, on breaking them open it will be observed that they are partly porous and have a glistening appearance contrasting with their dull exterior.

It is clear that the first stage of coke formation (from a good coking coal) in a coke oven is the expulsion (possibly extrusion) of some volatile matter from the coal, which binds together the coal particles into a loosely-coherent mass. The second stage would appear to be one of apparent liquefaction, in which the loosely-bound coal particles lose all semblance of their original shape and give a more or less regular porous structure. It is this stage of coke formation which has been particularly studied in the present research.

It is difficult to conceive of the "melting" of a complex substance like coal in the same way as sulphur or sugar melts. There is no direct evidence to show that more than 10 to 15 p.ct. of the coal substance can be obtained as liquid products (other than water) during carbonization. The evidence obtained by the action of solvents on coal appears to show that the largest proportion of the coal substance is of a nature almost as infusible as carbon itself. It would seem impossible for this large proportion of material—say, 85 to 90 p.ct.—which is of known resistance to solvent action, to be dissolved by the remaining 10 to 15 p.ct. What then is the nature of the apparent liquefaction of a coking coal during coke formation?

Theory of Surface Flow of Solids.

It is possible that the answer to this question may be found in the phenomenon of surface flow of solids under mechanical disturbance discovered and described by Sir George Beilby in his paper "Surface Flow in Crystalline Solids under Mechanical Disturbance" (Proc. Roy. Soc., 1903, A72, 218) and in his book "The Aggregation and Flow of Solids," London, 1921. The phenomenon of surface flow of solids, so well-known and widely accepted by metallurgists, seems to be little known to fuel technologists, despite the importance which Beilby attached to it in coke formation; and a statement of the outstanding facts of the phenomena concerned may, therefore, be made.

Beilby found that by firmly stroking a polished surface of a ductile metal with the finger covered with a thin wash-leather, no evidence of surface alteration was apparent; but on removing the surface layer of metal with solvents, the substrata were found to be deeply furrowed and ridged. The same phenomenon was observed with a freshly-cleaved surface of calcite. The furrows and ridges ran in the direction of the strokes with the forefinger. This phenomenon was explained by Beilby by assuming that the substrata had flowed under pressure like a viscous liquid, and had resolidified as soon as the pressure was removed. Flow lines were distinctly developed by a single stroke with an estimated pressure of 4 lbs. per sq.in., while the depth of mechanical disturbance was estimated to be 500 to 1000$\mu\mu$ (0·0005 to 0·001 mm.), or the thickness of several thousand molecules.

The surface skin after mechanical disturbance was found to possess increased hardness and tenacity, due, it is believed, to the breaking down of the crystalline units into a mobile or liquid state, which immediately congealed into a vitreous solid in which the capacity of flow was enormously reduced. It was found that by wire-drawing metals it was possible to reduce all the rougher traces of crystalline structure, and to reduce the whole substance to a fibrous and granular condition—not a homogeneous vitreous state, but an intimate mixture of the vitreous and crystalline states. By pressing in a mould at 60 to 80 tons per sq.in., vitreous gold of greater rigidity than that resulting from cold wire drawing was obtained. Gold wire drawn at $-182°$ had a tenacity of 22·4 tons per sq.in., while the tenacity of pure annealed crystalline gold was 7 tons per sq.in.

Another observation was that the action of solvents on solids also produced surface flow. For example, amalgamation of a plane gold surface with mercury, followed by the removal of the mercury by evaporation at a low temperature, left the surface heaped up in granular or drop-like forms. A similar action was apparent by the action of hydrofluoric acid on glass. The action of gas on metals (for example, ammonia on iron) was also found to give local liquefaction where gas passage had occurred, at temperatures many hundreds of degrees below the melting-points of the metals.

Beilby amply demonstrated the truth of his hypothesis of surface flow by careful work over a number of years, during which the necessary special technique was cleverly developed. In his book many examples of surface flow are recorded and made easily intelligible by numerous excellent photomicrographs. The central fact emerging from the work is the possibility of the surface molecules of a solid to an appreciable depth gaining, under mechanical disturbance (or solvent action), a temporary degree of freedom which allows them to take up a new aggregation, which, on removal of the pressure, becomes permanent. This heterogeneous arrangement of the surface molecules is called the "vitreous state," and the process of formation "vitrification." The new surface aggregation of the molecules confers on the solid greater rigidity than in the undisturbed state. The increase in rigidity or mechanical strength depends on the extent to which vitrification has occurred, this usually increasing with greater mechanical disturbance. The form which the molecules take up in the vitreous state is governed by the molecular forces of cohesion, and, at the extreme surface, by the force of surface tension.

Application to Coke Formation.

In the standard method for the determination of the volatile matter content of coals, coke buttons are obtained which vary greatly in appearance. It has long been generally believed (though rarely authoritatively demonstrated) that the best coking coals yield strongly-swollen coke buttons, while the poor coking coals yield only slightly swollen or even slightly shrunken coke buttons.*

If "fusion" were the only requirement for a coking coal, why is it that increased swelling power of a coal confers increased mechanical strength to the coke produced from it in practice? It may well be that the answer is that in coke formation the swelling power of the coal provides the mechanical pressure necessary for the flow of solid surfaces. The swelling of coke buttons is due to the evolution of volatile matter at a time when the coal is undergoing apparent liquefaction in passing through the plastic stage. In a coke oven the swelling of the coal is resisted, and a pressure is produced proportional to the swelling power of the coal. It may therefore be expected that the greater the swelling power, the greater will be the tendency for the flow of solid surfaces, and the more completely vitrified (and therefore the stronger) will be the resultant coke.

It is clear that appreciable pressures may be produced when using strongly coking coals in a coke oven,† where conditions are such that gas is produced at innumerable points. It is conceived that under these conditions the solid surfaces of the coal (which consists not only of the external surfaces of the particles, but also the pore walls) at a temperature of approximately 400° to 500° C. are subjected to gas pressures which may assume relatively high magnitudes. In these circumstances, it is possible that the solid surfaces flow under the pressures developed, and, on release of the pressures, assume the rigidity of the vitreous state. Since the extent of surface in relation to volume is enormous, the extent of the formation of vitreous surfaces would be correspondingly great, and with the best coking coals the extent of vitrification may be almost complete.

The gas pressures are developed inside the closed pores of the coke-forming mass; on the rupture of the pores and the evolution of the gas into the coke fractures or the free space between the uncarbonized coal particles, the pressure would fall practically to atmospheric pressure, so that the pressures developed in the pores would not be recorded by inserting tubes into an oven.

The gas pressure developed would not be the only factor causing vitrification, for, as Beilby showed, solvent action produces surface flow. Solution is always preceded by wetting (for it is known that the degree of wetting of a liquid or a solid is generally proportional to its solvent action), and the extent to which the liquid products of thermal decomposition wet the coal surface will also be important. The pressures developed will also affect the formation of vitreous surfaces by solvent action, for it has been shown by Hardy (J.C.S., 1925, 123, 1207) that mechanical disturbance aids the wetting of a solid surface by a liquid.

A further factor causing surface flow will be the actual evolution of the gas (as distinct from the gas pressures) during the plastic stage in a manner similar to that shown by Beilby to take place during the passage of ammonia through iron, and the emission of adsorbed air from copper. The swelling of crucible coke buttons is in itself evidence of the greater evolution of volatile matter during plasticity for the better coking coals. Little other direct evidence is available to show the amounts of volatile matter actually expelled from different coals over different temperature ranges, but the figures recorded in the following table (Foxwell, "Fuel," 1924, 3, 230) are of interest in this connection.

The evolution of volatile matter is over the range 400° to 500° for the Durham and South Yorkshire coals, but up to 500° for the South Wales coal. These latter results may therefore be a little high. All these coals are plastic over the range 400°

* See, for example, Mück, "Steinkohlen Chemie," 1881, referring to Westphalian coals; Schondorf, Preuss. Z., 23, 135, referring to Saar coals; see also Slater, "Fuel," 1927, 6, 82.

† See Foxwell, "Fuel," 1924, 3, 123; Simon, J. Iron and Steel Inst., 1880, I, 137.

TABLE I.

Coal.	Gas (Litres per 100 Grammes Coal).	Tar. P.Ct.	Total Volatile Matter. P.Ct.
S. Wales	6·26	1·26	24·0
Durham	6·29	1·06	32 6
S. Yorkshire	2·47	0·78	33·6

to 500°; the South Wales and Durham yield better cokes than the South Yorkshire coal. A non-coking Leicestershire coal which was plastic over the range 240° to 320° showed an evolution of only 1·37 litres of gas per 100 grammes of coal, but 2·03 p.ct. of tar up to 400°.

According to this view of coke formation, the extent to which vitrification occurs would vary according to the pressure developed in the pores of the coal, which has been shown to vary with the known coking values of a series of coals. It is actually found in practice that cokes made from the best coking (strongly swelling) coals exhibit greater rigidity than those made from inferior (non-swelling) coals. It may be noted also that laboratory cokes made from good coking coals have a much brighter surface (typical of the vitreous state) than those made from poor coking coals. In practice, also, cokes made from poor coking coals are dull, and often granular in appearance.

The author then went on to describe his experimental study of coke formation, in which a series of coals was selected, with carbon contents ranging from approximately 80 to 90 p.ct. on the ash-free, dry, sulphur-free, basis, including coals from South Wales, Durham, Cumberland, Yorkshire, Nottinghamshire, Staffordshire, and Leicestershire.

The first characteristic of coke formation, he suggests, is the development of a porous structure inside the individual coal particles. It has been argued that this depends to a great extent on the gas pressures developed inside the coal material during the plastic stage. It may well be that the liquid products of decomposition exert an influence on this phase of coke formation, for the wetting of the pore surface by a viscous tar would tend to prevent the escape of gas, thus allowing it to accumulate and cause the phenomenon of surface flow. Fischer, Broche, and Strauch ("Fuel," 1925, 5, 466) have given evidence of the greater viscosity of the pressure benzene extracts (which are supposed to be closely connected with the liquid products of distillation) of coals of high carbon content compared with those of lower carbon content.

In this phase of coke formation the forces which are in equilibrium are the cohesion of the coal (*i.e.*, the forces of molecular attraction resisting change of shape or state) and the gas pressures developed in the pores. Cohesion is greater the closer the packing of the molecules; and the force of cohesion would be expected to be greater in durains, which are usually of high specific gravity, than in clarains. If, in addition, the gas pressures developed during the plastic stage of coke formation in durains are smaller than in the corresponding clarains, a stronger and more coherent residue may be expected to result from coke formation from lumps of durain compared with lumps of clarain. This is indeed found to be the case, and very strong cokes may be prepared from the hards of good coking coals.

No direct determination of the cohesive forces of different coals is possible, but a rough guide is the ease with which lumps, which are not much interbanded, may be broken. Harder coals showed a pronounced tendency to break with a conchoidal fracture, while the softer coals broke with parallel fractures, and the softest coals of all produced dust in breaking. The friability of the strongly coking coals of high carbon content is a typical property which greatly limits the use of such coals. Higher up the scale, the anthracite exhibited the greatest strength. In this series the strongest coals are those of fairly low carbon content, while the coals of higher carbon contents exhibit decreasing mechanical strength (or cohesive force). The hards also show a greater cohesive force than the brights.

This factor (cohesion) would appear to have a very important bearing on coke formation, for those coals which exhibit the greatest cohesive forces—namely, the hards and the bright coals of fairly low carbon content—give the least swollen cokes. On the other hand, the coals which exhibit the smallest forces of cohesion yield the most swollen cokes.

A second series of experiments was concerned with the formation of coke from crushed fine coal. Coke formation from crushed fine coal must involve the binding together of the individual coal particles to form a coherent mass if a serviceable coke is to result. It is in this phase of coke formation that wetting phenomena may be of particular importance. As elsewhere recorded ("Fuel," 1925, 4, 463), the liquid extruded from the coal particles consists mainly of hydrocarbons, and there is evidence to show that these hydrocarbons will more easily wet the coal surfaces the closer the composition of the coal surface molecules resembles that of the wetting liquids. In other words, the higher the carbon content of the coal (or the lower the oxygen content), the more easily will the liquid hydrocarbons wet the coal surfaces.

The higher the carbon content of the coals, the more pronounced is the binding together of the individual coal particles. The liquid extruded from adjacent coal particles wets their surfaces, but the weak cementing action of the thin oil films round relatively large coal particles would be insufficient to give a strong coherent mass, and it is necessary for swelling of the coal particles to occur before the molecular forces of cohesion can act between the surfaces of adjacent particles to cause coalescence. It would appear that internal gas pressures causing swelling are the principal cause of the loss of identity of individual coal particles, for swelling must occur before adjacent particles can coalesce by cohesion (which can act only over relatively short distances.)

It may be remarked that the fineness of the coal used for coking or the use of compression would be expected from this theory to exert an important influence on the strength of the resulting coke. The more finely ground the coal, or the greater the compression used, the greater would be the resistance to gas passage between the coal particles, and the greater the pressures developed, and, therefore, the greater the tendency for vitrification to occur. Increasing the rate of heating (by reducing the width of the oven) would also result in greater gas pressures, this again aiding vitrification.

In the crushed-coal series, contrary to the results obtained in the lump-coal series, the force of cohesion has been operative to a greater degree in the coking residues of coals of high carbon content than those of low carbon content. An explanation of the phenomenon may lie in the greater ease of oxidation of coals of low carbon content. Even under the conditions of the experiments in which coal was crushed immediately before use, it would be possible for air to be adsorbed at the coal surfaces (or to react with the surface molecules) with coals of low carbon content. It is well known that the presence of thin films of air on broken china surfaces, for example, prevents the jointing of such surfaces by the force of cohesion alone, and it is necessary to use a substance like seccotine, which displaces the air films and wets the solid surfaces, before the force of cohesion can operate. It is conceivable that a similar process occurs in the preliminary binding together of crushed coal, and that the liquid hydrocarbons extruded from the coal particles may displace the air films and wet the solid surfaces. The subsequent swelling of the coal particles could then bring adjacent surfaces within the range of the molecular force of cohesion to allow the final binding or coalescence of the particles into a coherent aggregate. When binding does not occur, one or more of several factors may be operative: (1) A suitable quantity of wetting liquid may not be extruded to displace the air films (possible in the case of anthracite); (2) the altered surfaces of the coal particles may be such that a low wettability results (this would appear to be more probable in the case of the easily oxidizable coals of low carbon content); (3) wetting may occur, but the coal particles may not swell sufficiently to bring adjacent surfaces within the range of the molecular forces of cohesion (probable in the case of hard coals of high carbon content, and to a less extent in the bright coals).

Thus, with crushed coal samples the force of cohesion may be more evident in the coking residues of coals of high carbon content (in lump coals the reverse would often appear to be true). A further example of this phenomenon is to be found in the ease with which crushed coals of high carbon content may be matted together on rubbing in a mortar. This process has, indeed, been suggested as a means of determining relative coking abilities of coals (see "Fuel," 1925, 4, 472). It may here be remarked that the formation of pure coal briquettes by the application of mechanical pressure alone gives evidence of the operation of the force of cohesion in different degrees, and, at the same time, provides an example of the formation of vitreous surfaces in coal by the action of pressure alone. The fact that such pure coal briquettes may be carbonized without losing their external shape indicates that, at the surfaces where coalescence has occurred, the hardened vitreous state has been assumed before gas pressures due to thermal decomposition are developed. The hardened vitreous surfaces resist distortion, and release of gas pressure is made possible by the rupture of the undistorted cell walls, yielding a final product with an interconnected small pore structure which has been found to exhibit special properties on combustion. The cell structure may be likened to that of wood charcoal or of cokes made from lumps of hards.

CONCLUSIONS.

The author summed-up his conclusions as follows:

It is suggested that coke formation primarily depends on the surface flow of the solid surfaces of a coking coal under mechanical disturbance due to gas pressures developed inside individual coal particles, aided by solvent action of the liquid products of decomposition and, to a smaller extent, by the passage of gas through the coke-forming mass. A second phase of coke formation which comes into operation when crushed fine coal is employed is the binding together of the individual coal particles to form a coherent aggregate. In both phases of coke formation, internal gas pressure causing swelling of individual coal particles is an important factor. The greater the gas pressures developed, the greater would be the extent of vitrification and the greater the mechanical strength of the coke produced.

In coke formation from crushed coal particles, wetting phenomena would appear to be of great importance. In the forma-

tion of coke from lump coal and from crushed fine coal, the final "binding agent" is the molecular force of cohesion, but the operation of this force in the case of crushed fine coal is greatly dependent on the primary wetting of the coal surfaces with suitable wetting liquids.

Application of Experimental Study.

From the series of coals examined, there would appear to be a simpler general relation between the ultimate analyses of coals and their relative coking abilities than is usually accepted. No comparisons are possible unless a basis such as the ash-free, dry, sulphur-free basis is employed; but on this basis a fairly simple relationship exists between composition and coking power. In general, the bright coals with carbon contents higher than 85 p.ct. (and probably below 91 p.ct.) are coking coals; and the higher the carbon content within these limits the better is the resultant coke in coke oven practice. Coals of carbon content of about 82 to 84 p.ct. would appear to yield an inferior metallurgical coke, and coals with a carbon content lower than 82 p.ct. would appear to be non-coking in general practice, though an inferior coke might be produced from such coals by more rapid heating or other special methods of treatment. The hard coals, if used in a finely-ground condition, would probably only yield an inferior coke even if of high carbon content. Because of their greater hardness compared with bright coals, hards usually do not appear in great proportion in the fine coal resulting from mining operations and preparation of the coal for the market; and their study in this connection is of more academical than of practical importance.

In coking practice the tendency of coals to swell is almost entirely overcome, since coking occurs in vertical layers, and the swelling tendency of coal in the lower levels of an oven is opposed by an equal force, due to the same tendency, in higher levels of the oven. Consequently, a bright spongy coke is only formed from a strongly swelling coal in the upper layers of coal in an oven. In a vertical retort, on the other hand, when nut coal is used, the spaces between individual coal particles are relatively large, and swelling (of a Durham coal, for example) may occur. In practice it is well known that much trouble is often experienced with certain Durham gas coals which tend to hang in the retort. In a horizontal retort there are only small spaces between individual coal particles, and since heating does not occur in vertical layers as in a coke oven, the charge is free to expand upwards. A light, porous coke may therefore result when using certain Durham coals.

In gas-works practice it is necessary that a coherent residue of suitable mechanical strength should remain on carbonization. From the results of the author's investigation, it would appear that, employing lump coal in a vertical retort, such a result could be achieved by using all coals (bright or hard) with carbon content of over approximately 81 p.ct., and the strongest cokes would result when using coals of carbon content lower than about 84 p.ct. In horizontal retort practice, the coal would have to have a carbon content greater than 82 p.ct.

COKE IN RELATION TO SOME OF ITS INDUSTRIAL AND DOMESTIC USES.

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While the suitability of coke for any particular purpose is largely governed by such factors as size, ash content, fusibility of ash, and moisture content, the influence of which is usually fairly obvious, there are other factors the significance of which is less easy to elucidate. Some of the properties of coke to which reference may be made are its reactivity towards carbon dioxide as measured by the speed of the reduction to carbon monoxide; its reactivity towards steam, which it is usual to assume varies with the reactivity towards carbon dioxide; its reactivity towards air, or combustibility as measured by the speed of combustion at some relatively low temperature; and its ignitibility, which is usually expressed as the lowest temperature above which the coke will continue to burn in air without any independent supply of heat.

Reactivity of Coke towards Carbon Dioxide.

In considering some of the uses of coke, it is necessary to have relative carbon dioxide reactivity values, for reasons which become apparent as each use is considered separately as follows:

(1) In the water gas process a coke which is least reactive towards carbon dioxide is best suited for the "blow" period, as the reaction $CO_2 + C = 2CO$ is curtailed, and consequently more heat can be stored in the fuel bed. On the other hand, a highly reactive coke is most efficient for steam decomposition during the "run" period. The consequent difficulty of deciding which type of coke shall be used in the water gas plant is discussed at a later stage in the paper, but obviously it is desirable to know accurately the relative reactivities of the cokes which are available.

(2) As a domestic fuel, coke is used either in the open grate or in the closed stove. In the former case it is an advantage to use a highly reactive fuel, so that there shall be a maximum flame production due to the combustion of carbon monoxide in air above the fuel bed. In closed stoves, unless provision is made for the admission of secondary air, a highly reactive coke is not desirable in so far as heat is lost due to the reduction of carbon dioxide to monoxide. If, on the other hand, combustibility at low temperature varies directly with reactivity towards carbon dioxide at higher temperatures, then the first disadvantage is outweighed by the advantage of having a fuel which ignites easily and which will maintain a fire of small proportions.

(3) The most suitable fuel for producers is clearly one which reacts most readily with carbon dioxide.

In examining cokes for reactivity towards carbon dioxide, it has been sought to determine in part their suitability for each of the above uses.

Determination of Reactivity.

The method adopted for determination of reactivity of coke towards carbon dioxide incorporates the principles of methods used by several other workers. In order to secure results which are concordant and which are not contradictory to general experience outside the laboratory, it is essential to pay particular attention to the following factors:

(1) The sample actually tested in the apparatus must be strictly representative of the bulk.
(2) The conditions chosen for the small-scale tests should be those which will reveal the differences which exist between the cokes.
(3) The temperature must be maintained within small limits.
(4) Special account must be taken of the fact that coke changes in reactivity (sometimes rapidly) as the test proceeds.

Experimental.

In sampling coke, the normal practice was to take a bulk sample of about 15 cwt. from as large a group of retorts as possible. This was screened into breeze and coke, each fraction weighed, and a 7-lb. sample taken from each for laboratory work. These small samples were further broken down under specially devised conditions whereby 30 p.ct. of the whole remained as coke which passes a 10 but does not pass a 20 I.M.M. screen. By fixing in this way the percentage of coke of final standard grade, there is obtained a representative sample with which another coke sample obtained in the same way can be justly compared. Further, a mixture of graded coke and breeze can be made in the proportion in which these occurred in the original 15-cwt. sample.

With the above method of sampling, more accurate comparisons can be made on the small scale, with correspondingly

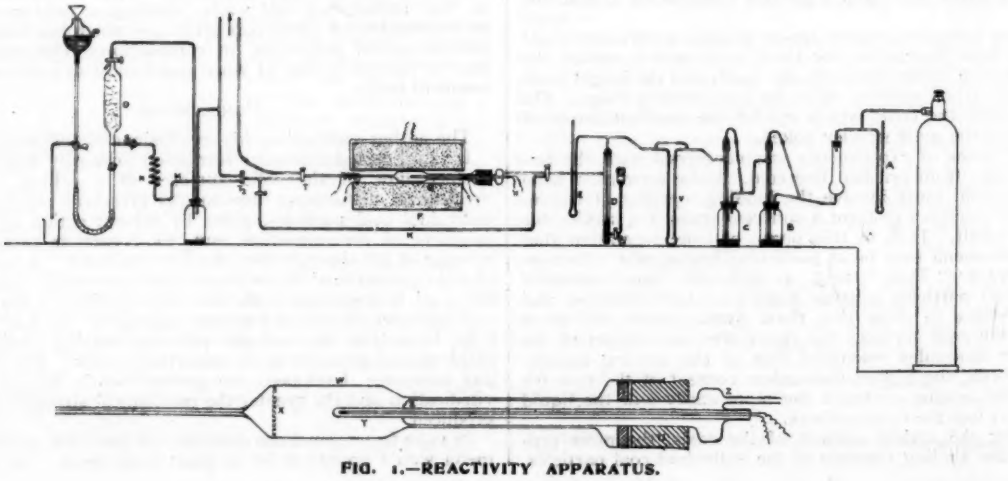


FIG. 1.—REACTIVITY APPARATUS.

small quantities of material, than on experimental stoves where bigger coke and larger quantities have to be employed, and where, very often, only a small proportion of the coke charge functions in the tests. No stove test for coke reactivity or combustibility is known in which the temperature of the fuel bed can be kept at a predetermined standard. The following laboratory test, however, provides reliable data which can be used in conjunction with other information for determining the relative suitability of cokes for various industrial and domestic uses.

The apparatus is shown in fig. 1. The carbon dioxide is supplied from a cylinder, and controlled by a fine adjustment valve so that the rate of flow of gas is about 50 c.c. a minute. The valve can be adjusted to give a definite constant pressure on the mercury gauge A. If the pressure should tend to vary, this variation is corrected by two gas-flow regulators B and C. The gas then passes through a glass flow gauge V, which gives the actual flow of gas in c.c. per minute. Any variations in back-pressure in the coke column or capillaries are corrected by adjustment of the level of sulphuric acid in the tube D; the back-pressure being registered by gauge E. From the regulator D, the gas travels either through the coke in the silica tube G, heated in the furnace F, or through a by-pass K joining the main capillary again on the other side of the tap T. It then passes through a two-way tap T_2 either to atmosphere or, by way of the tube M, through the lead coil N (to reduce the gas to atmospheric temperature), and is collected in gas receiver O, which has been filled with brine from the reservoir P. As the gas enters the receiver the brine flows away through a three-way tap Q placed on a level with the inlet S; this arrangement ensuring that the gas is collected throughout at atmospheric pressure. The silica tube* containing the coke to be tested is made in two parts as indicated. A predetermined volume of coke (10 to 20 I.M.M. mesh)—this volume being used in all reactivity determinations—is charged into the container W, which is provided with a finely-perforated silica base X. The thermocouple sheath Y, which is welded into the gas supply tube Z, is then inserted through a large rubber bung U. The silica tube so charged is placed in position in the furnace F when the latter has reached a temperature of about 980° as indicated by the couple H, and is then connected up with the apparatus as a whole; the carbon dioxide passing meanwhile to atmosphere through the by-pass K. The temperature of the coke reaches 950° in about 15 mins., and is maintained at this temperature as far as possible throughout the test. When 15 mins. have elapsed after placing the coke in the furnace, the carbon dioxide is diverted from the by-pass and passed through the coke for a period varying from 2 to 4 hours. Samples of gas are collected every 10 to 15 mins., but instead of determining the composition of the samples by analysis, the proportion of carbon dioxide being converted at the time of sampling is calculated from the time (accurately noted for every sample) taken in collecting 150 c.c. of gas in the receiver O; corrections being made for temperature and pressure. By this means the reactivity of the coke at any given time in the 4 hours' test can be determined in about 2½ mins., and a curve plotted showing reactivity (expressed as p.ct. CO_2 converted) at 950°, or any other selected temperature, against time in minutes for a period of 4 hours, or more if necessary. The rate of flow of carbon dioxide is checked immediately before and after each test by passing it through the by-pass and actually timing the period required to collect 150 c.c. in the receiver O, checking the flow gauge reading each time. The temperature of the coke is controlled by two thermocouples at H and J; and it is possible to work at 950° with a maximum error of 2°, the thermocouple being checked from time to time against pure silver melting at 961°. It has been found that a temperature difference of 4° affects the reactivity by varying small amounts which cannot be regarded as of practical importance. The reactivities noted below range from 15 to 70 p.ct. of carbon dioxide converted (see fig. 3).

The reactivities obtained during the first half-hour by the method outlined above are somewhat inaccurate, as indicated in fig. 2. Curve A is produced in the ordinary way from observations made in testing a selected horizontal coke with carbon dioxide at 950°. Curve B is the result of an experiment in which nitrogen was used instead of carbon dioxide; conditions being otherwise the same as for curve A. The change in volume, actually produced by the expelled volatile matter mixing with the nitrogen, was expressed as an effect due to the conversion of carbon dioxide. In this way curves B and A are properly comparable, and it is evident that the possible error due to volatile matter is of no practical importance. The volatile matter content of this coke was 3·6 p.ct., which is higher than that of any other coke tested. Furthermore, numerous gas analyses have confirmed the accuracy of the method of calculating the conversion of carbon dioxide from the gas velocity observations.

The curves A and B in fig. 3 illustrate the effect upon the reactivity of the coke of carbonizing the same coal under different conditions. The conditions which differ in the two

* This part of the apparatus was adopted after one of the authors had had the opportunity of seeing the coke reactivity apparatus used at H.M. Fuel Research Station.

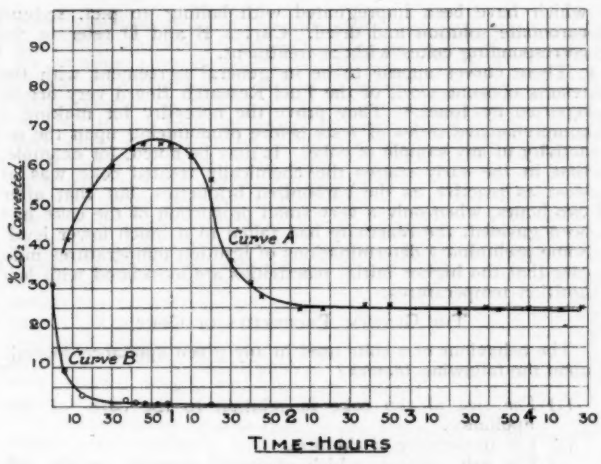
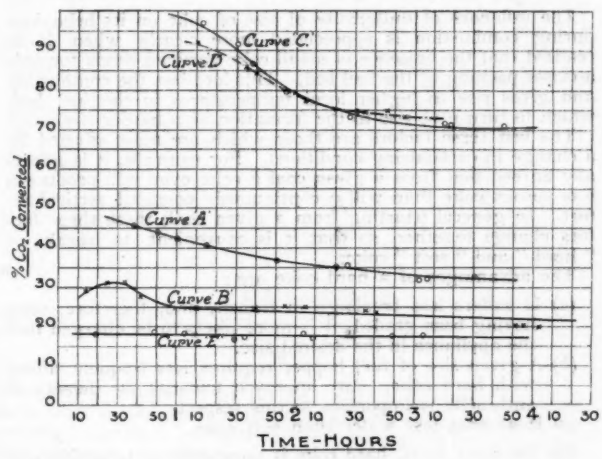


Fig. 2.

horizontal retort houses in this instance are the method of charging the retorts, the temperature of the combustion chambers, and the free space in the retorts.

The high reactivity of coke from blended coal briquettes, as represented by curves C and D in fig. 3, should be noted. This



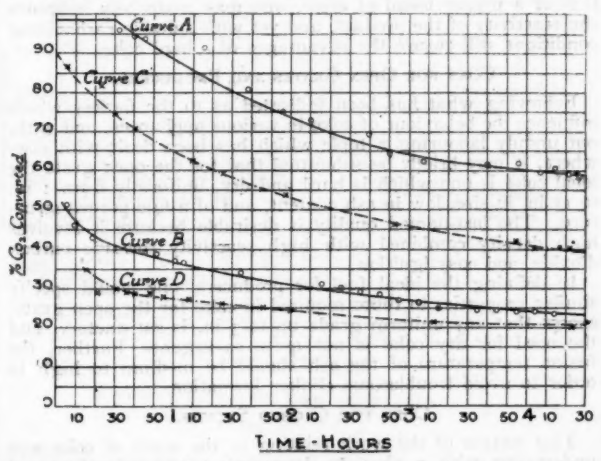
Reactivity tests. A and B. Horizontal retort cokes. C and D. Briquettes. E. Beehive coke.

Fig. 3.

coke was produced in a continuous vertical retort from a briquetted mixture of Durham coking coal with South Yorkshire non-coking coal.

The relatively low reactivity of beehive coke is indicated by curve E.

The rapidity with which the reactivity of treated cokes falls away as time increases is shown in fig. 4, where curves A and C represent vertical and horizontal retort cokes respectively,



Reactivity tests. A. Treated vertical retort coke. B. Untreated vertical retort coke. C. Treated horizontal retort coke. D. Untreated horizontal retort coke.

Fig. 4.

which have been impregnated with boiling 10 p.ct. sodium carbonate solution and dried. Curves B and D refer to the corresponding cokes without treatment.

These curves appear to be in general agreement with the results of some work of the Fuel Research Board very briefly reported by Jones.* They prove the necessity for making a comprehensive series of tests before pronouncing upon the reactivity of any sample of coke. It may be noted, for example, that in the early stages the chemically treated coke was at least as reactive as the carbonized briquettes, but that after two hours, when only a very small proportion of the coke had been gasified, the reactivity had fallen to a much lower level. Some preliminary determinations of ignition temperatures indicate that the higher initial reactivities are associated with low ignition temperatures.

The General Properties of Coke.

The behaviour of a coke used in any given appliance depends upon the following factors:

(1) The size of the coke in relation to the size of the appliance.
(2) The uniformity of the size.
(3) The ash content, which obviously depends on the ash content of the coal.
(4) The fusibility of the ash, which again depends on the nature of the original coal ash.
(5) The moisture content, which depends on the coke quenching system.
(6) The weight per unit volume.
(7) The hardness.
(8) The porosity of the coke or the nature of its surface.

The influence of uniformity of size of coke on its behaviour during combustion is appreciated more clearly when it is realized that the presence of small coke particles tends towards a closer packing of the fuel bed. This localizes the combustion and gives rise to higher local temperatures in the fuel bed, which in turn give rise to the formation of a harder clinker.

The last three factors are those which are most affected by a change in carbonizing conditions. For example, it is generally agreed that from a given coal a coke oven will produce a less porous coke than will a continuously operated vertical retort. In general (starting from a given coal) these three factors change together, so that it is convenient to speak of "hard" and "soft" coke.

The advantages of a hard coke are:

(*a*) It suffers less breakage in transit, and, therefore, once having been graded, it is more likely to be charged into the appliance in the desired size.
(*b*) A given size of fuel hopper requires less frequent filling with hard coke. Any approach towards the density of anthracite is important in this respect.
(*c*) It absorbs less water than soft coke.

On the other hand, hard coke is more difficult to ignite, and its combustion is more difficult to control in a small furnace such as is found in the English water heater, as is explained below.

These general properties should be considered in relation to the factors which govern them. Thus the type of carbonizing plant does not govern the ash content of the coke, and it only affects the water content in so far as the latter depends upon the porosity. The method of operating a given carbonizing plant may, however, have a greater effect upon the water content. The factors most governed by the choice of carbonizing plant are density, hardness, porosity, and reactivity, though these are by no means unaffected by the method of operating the plant or even by the choice of coal. For example, by selection of a proper blend of coals, one may materially influence the reactivity of the product, and yet with suitable carbonizing conditions still ensure the advantages of a hard coke.

Coke for Open Grates and Producers.

Following what has been indicated as to the factors which influence the behaviour of coke in various appliances, and without unduly labouring a topic which has been dealt with elsewhere, it may briefly be submitted that for the open grate the ideal coke is one which is hard and dry, uniformly from 1 in. to 1½ in. in size, low in ash content, and of a fine porous structure. The last-named quality is desirable because it involves high density combined with high reactivity towards carbon dioxide, and easy ignition.

In defining the ideal fuel for producers, one would specify similar properties to those required in coke for the open grate, except that any uniform grade up to 3 in. is satisfactory, and the need for dry coke is not quite so urgent. Further, the fusion temperature of the ash should be medium to high in order to avoid troublesome clinker formation.

Coke for Closed Stoves.

This section of the work relating to the study of coke was undertaken with a view to determining which is the most suitable fuel to use in the small closed stoves now being so generally installed for water heating in this country. It appears that coke ovens are popular in America not only because of their simplicity of operation and the low labour and maintenance costs involved, but also because of the popularity of the coke for domestic use.

In view of English experience of the behaviour of hard and soft cokes in domestic appliances of relatively small size, it is interesting that not only are there practically no open grates in America, but that the small water heater such as is being installed in many English houses is almost unknown. The coke is generally burnt in a relatively large closed furnace. The average American stove has a grate area of about 3 sq.ft., whereas in England the grate area of the average coke boiler is less than 1 sq.ft. Further, the ash and water contents of American cokes average 7 p.ct. and 4 p.ct. respectively—figures which are frequently exceeded in English practice.

In the light of the experimental evidence furnished by comparative tests on large and small stoves as described below, it seems that, whereas Americans may be justified in using dense oven coke for their domestic heaters, the small stoves used in England require coke which is highly combustible and easily ignited. Further, if a coke can be made which combines the desirable qualities of high weight per unit volume, hardness, high combustibility, and ease of ignition—and it appears that such a coke could be made in coke ovens from blended and perhaps briquetted coals—then this fuel is the ideal for English closed stoves.

It has also to be remembered that, with the small English stoves, the probability of the fire going out accidentally is far more pronounced than with the large American stove. Hence the need in England for a coke with a low ignition point.

The requirements common, however, to both types of stove are that the fire, once lighted, should with reasonable attention remain burning for an indefinite period, that it should burn throughout the night with no attention and with very low fuel consumption, and that too frequent stoking during the daytime, when the heat demand is large, should not be necessary. It is common experience that a dense or hard coke must be burnt at a rate faster than is desired during the night, or the fire quickly dies out. This difficulty of control is not experienced in the larger furnaces such as are common in America; and it is suggested that what happens when such a furnace is "banked up" during the night is that combustion ceases in that part of the fuel bed adjacent to the cooling surfaces, but that the blanket of partially burnt coke thus produced insulates the centre core of the fuel bed and prevents it from being cooled to a temperature below that of ignition. In the case of a small furnace, a larger proportion of the fuel bed is subjected to the cooling action of the surfaces, and in the extreme case there is no core of burning coke left.

The soft coke, however, is more reactive towards air, so that, other factors being equal, it is capable of generating heat equivalent to that abstracted by the surfaces, and is not cooled below the ignition temperature. The argument might be extended by saying that because the slow combustion of coke in a large furnace is dependent upon the insulating effect of the outer layers of non-burning coke, a dense coke is more easily controlled than a light coke (in a large furnace) since the insulation is more efficient. Furthermore, the air which passes into the stove through the grate tends to be drawn to the hottest spot in the fuel bed, with the joint result that little cooling is effected and most of the air is efficiently used in maintaining combustion. This, of course, applies with greater advantage to the large stove.

Experimental.

Two series of experiments were carried out on closed stoves with respective grate diameters of 8 in. and 24 in.

The first series comprised a number of short runs using:

Fuel No. 1, screenings from coke-oven coke which would represent unusually combustible oven coke.
Fuel No. 2, a fuel specially selected for its unreactive character.
Fuel No. 3, ordinary vertical retort coke from a continuous vertical installation.

The second series comprised a number of 18-hour runs using:

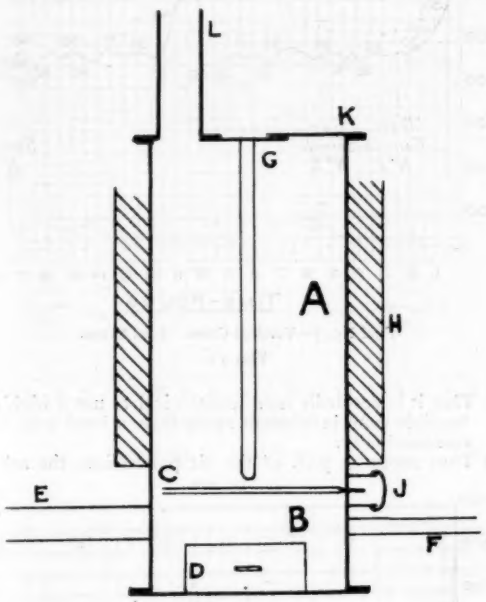
Fuel No. 4, screenings from coke-oven coke.
Fuel No. 5, a normal horizontal retort coke.
Fuel No. 6, an ordinary cut coke-oven coke.
Fuel No. 7, vertical retort coke taken from the same installation as Fuel No. 3 when different coals were being used.
Fuel No. 8, a fuel selected for its high combustibility.

The tests in both series were made with a view to determining the minimum supply of air which would maintain steady combustion in the fuel bed. The usual precautions were taken to ensure that reliable and properly comparable results were obtained—in that all fuels were carefully graded to a standard size, ½ to ¾ in.; the air was measured through a wet meter into the ash pit; all other possible leakages of air into the stove were eliminated by carefully cementing all joints; the fire was lighted under standard conditions of time and of gas and air supply; the fuel bed was thoroughly raked free of ash before reducing the air to a minimum. During the test the tempera-

* "Fuel Econ.," December, 1926, p. 41.

ture of the hottest zone in the fuel bed was measured every five minutes by means of a thermocouple protected by an iron sheath let down through the centre of the coke charge.

The small stove was of the simplest design, and consisted of the following parts, as indicated in fig. 5: A wrought-iron cylindrical chamber A, 8 in. in diameter, into which the fuel



Experimental stove.

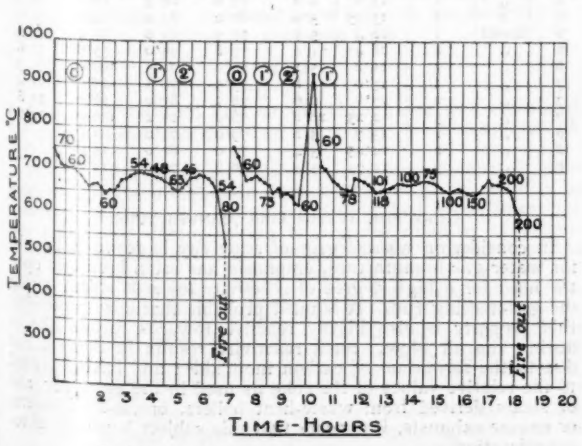
Fig. 5.

was charged through the door K; an ordinary circular cast-iron grate C, which could be shaken with a tool inserted through a port J fitted with a screw-on cap, this port also serving for cleaning the fire; an ash pit B fitted with a door D for removal of ash; a main air-supply pipe E of large diameter to ensure good distribution; a gas burner for lighting the fire and determining ignition points—not shown, but situated immediately below the grate and specially designed to burn with a large excess of air, which was supplied together with the gas by way of the inlet F, and in measured amounts; a water-jacket H kept at a standard temperature, and regulated by means of a gas ring burner or cold water; an iron thermocouple sheath G; a chimney L.

The large stove was constructed on precisely similar lines, and had a grate diameter of 24 in.

In the first series of tests the coke was lighted by an ordinary Bunsen gas flame, and then a large unmeasured excess of air was passed into the ash pit until vigorous combustion was proceeding in the fuel bed to a height of about 3 in. The air was then shut off, the fuel bed well shaken until ash-free, and the stove finally closed up at all points, with a reduced and measured amount of air passing into the ash pit from the meter. Various quantities of air were tried until the minimum temperature was ascertained at which combustion could be maintained. The air was then regulated to maintain the fuel bed approximately at this temperature. It should be noted that this temperature is higher than the ignition temperature as defined earlier in this paper, owing to restriction of the air supply.

In the second series of tests on the small stove, the coke

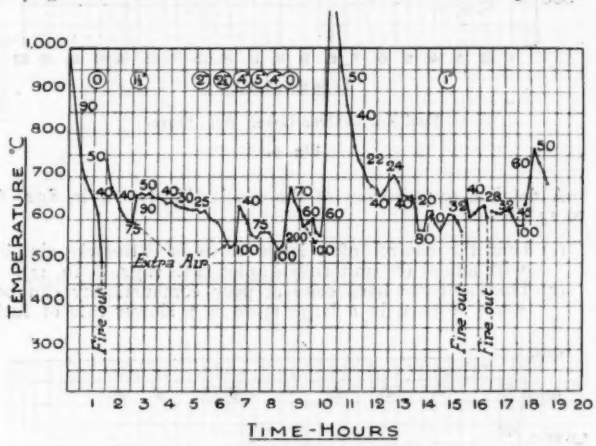


Fuel No. 4—Oven Coke Screenings. 8-in. Stove.

Fig. 6.

was lighted under carefully controlled conditions; both air and gas being measured. When ignited, the fire was intensified for 30 mins. with air passing at the rate of 190 c.ft. per hour. It was then thoroughly cleaned as in the first series, and the test carried on for 10 hours. Air was then supplied at the rate of 280 c.ft. per hour for 30 mins., and after the fuel bed had been raked as free of ash as possible the test was carried on for a further 8 hours. The coke charge was weighed before each test, and the entire contents of stove and ash pit were weighed again after the test, so that an approximate idea of the fuel consumption corresponding to the minimum air requirement could be obtained. Gas samples were taken from a point immediately above the fuel bed at various times during the tests, and analyzed, in order to check the accuracy of the deductions drawn from the values observed as to minimum air rates. The times at which these samples were taken are indicated on the diagrams, and the results of the analyses given in Table I. show the extent to which complete combustion was obtained, and to which we are justified in taking the rate of air supply as a measure of the rate of combustion.

It is interesting to note that on one occasion, when the air supply was completely shut off below the grate of the stove, but when a leakage of air was permitted through the cover, a bright fire was maintained in the centre for about 15 hours.

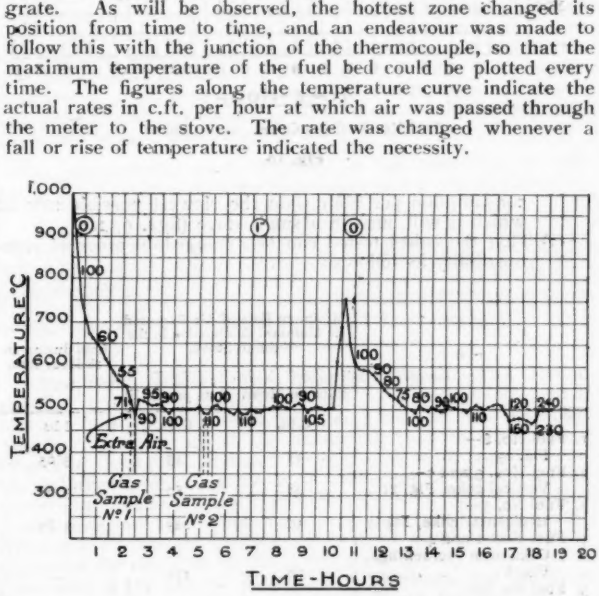


Fuel No. 5—Horizontal Coke. 8-in. Stove.

Fig. 7.

A careful examination of the fuel bed showed that air must have been passed downwards through the cold coke near the periphery and then upwards through the core of burning coke, so maintaining combustion.

In the accompanying diagrams, the figures in circles indicate the height of the hottest spot in the fuel bed above the grate. As will be observed, the hottest zone changed its position from time to time, and an endeavour was made to follow this with the junction of the thermocouple, so that the maximum temperature of the fuel bed could be plotted every time. The figures along the temperature curve indicate the actual rates in c.ft. per hour at which air was passed through the meter to the stove. The rate was changed whenever a fall or rise of temperature indicated the necessity.

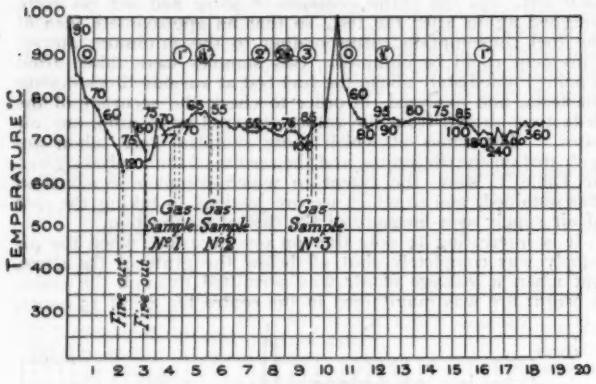


Fuel No. 5—Horizontal Coke. 24-in. Stove.

Fig. 8.

Figs. 7, 9, and 11 show how necessary it was to maintain the temperature of the fuel bed above a certain minimum—which varied according to the coke being tested—if it was desired to keep the fire burning with a fairly uniform and small supply of air. This minimum temperature for oven coke was

evidently 730° to 750°, whereas for vertical coke it was 750°. When the temperature was allowed to fall below the limit, as in figs. 7 and 9, either the fire rapidly died out, or large excesses of air were required to keep it alive, with very irregular temperature effects. Fig. 7 would probably have been more regular, with an air supply of 50 c.ft. per hour or less, had this principle been observed more carefully.



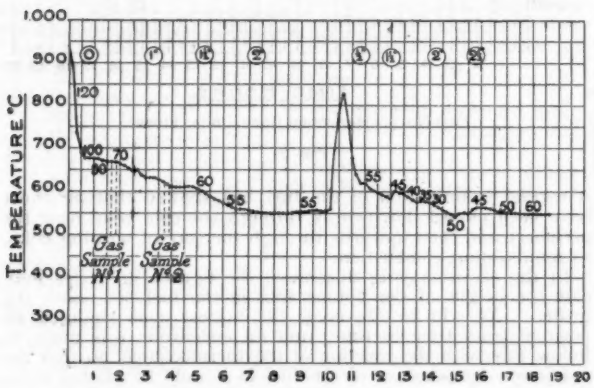
Fuel No. 6—Oven Coke. 8-in. Stove.

Fig. 9.

A detailed examination of the results illustrated in figs. 6 to 13 shows:

(1) That the control of a large stove is extremely simple with any of the uniformly-graded fuels (figs. 8, 10, 12).

(2) That a dense hard coke of poor combustibility can be made to burn in a large stove at a slower rate of fuel



Fuel No. 6—Oven Coke. 24-in. Stove.

Fig. 10.

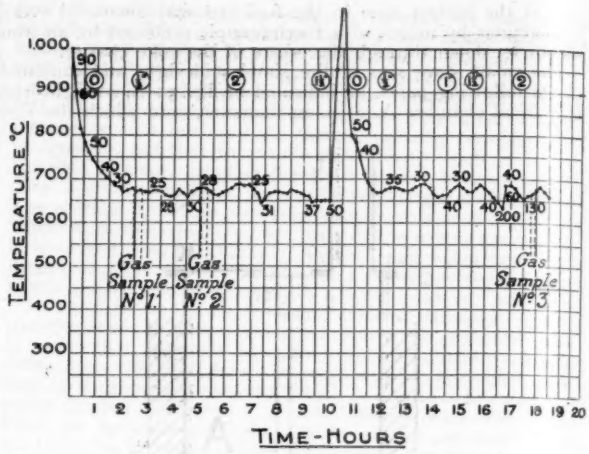
consumption per hour than the slowest possible rate at which it will burn in a small stove (figs. 9, 10).

(3) That the cokes tested can be arranged in order of combustibility as follows:

—	Minimum Rate of Air Required to Maintain Combustion in the Small Stove.		Loss during an 18-Hour Run.
	Rate per Hour.	Rate per Sq.Ft.	
	C.Ft.	C.Ft.	Lbs.
1. Fuel No. 8— Fig. 13	15	43	3·65
2. Fuel Nos. 3 and 7— Vertical coke, Fig. 11 .	28	80	3·88
3. Fuel No. 5— Horizontal coke, Fig. 7	50	143	4·65
4. Fuel Nos. 1 and 4— Coke-oven screenings, Fig. 6	60	171	..
5. Fuel No. 6— Coke-oven coke, Fig. 9	70	200	5·36
6. Fuel No. 2	84	240	..

(4) That the quantities of air supplied per sq.ft. of grate area on the large stove are very small in contrast with those found necessary on the small stove.

Fuel No. 7 was kept burning with 11 c.ft. per sq.ft.
" " 5 " " " " 32 " " "
" " 6 " " " " 18 " " "

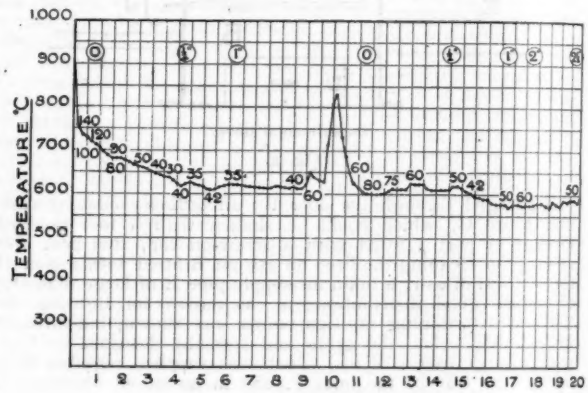


Fuel No. 7—Vertical Coke. 8-in. Stove.

Fig. 11.

(5) That it is decidedly more economical to use a highly combustible coke in a small stove than a hard coke of poor combustibility.

(6) That about 80 p.ct. of the air passed into the ash pit is



Fuel No. 7—Vertical Coke. 24-in. Stove.

Fig. 12.

consumed in passing up through the fuel bed in both large and small stoves (Table I.).

(7) That in nearly all the tests the air requirements are larger in the second period than in the first, owing to the blanketing effect of the ash.

TABLE I.—*Flue Gas.*

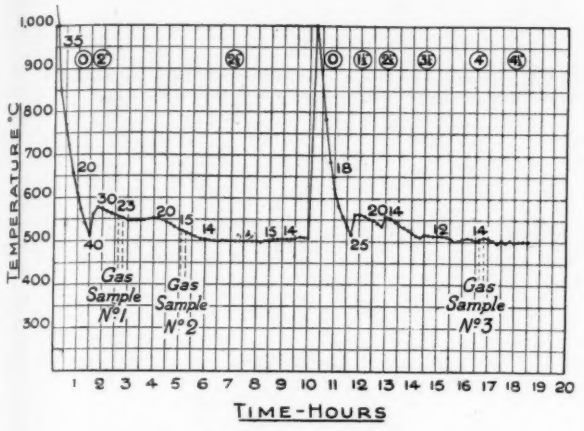
Fuel No.	Stove.	Sample No.	Oxygen Consumed.	Residual Oxygen.	Nitrogen.	Percentage Air Consumed.	Quantity of Air Supplied. C.Ft. per Hour.	Quantity of Air Consumed. C.Ft. per Hour.
5	Large	1	16·5	3·4	79·1	83·0	..	..
5	"	2	15·25	4·0	80·3	79·5	..	..
6	"	1	13·0	6·6	79·6	66·5	85·0	56·5
6	"	2	15 35	3·9	80·0	80 0	64·6	51·7
6	Small	1	16·4	3·7	79·3	81 6	77·4	63·0
6	"	2	18·4	1·4	79·8	93·0	55·5	51·6
6	"	3	14·6	5·1	80·0	74·5	100·0	74·5
7	"	1	15·0	4·6	79·5	76 5	28·0	21·4
7	"	2	17·6	2·6	78·7	87·0	26·0	22·6
7	"	3	2·25	18·8	78·8	11·2	130·0	14·6
8	"	1	13·7	4·8	79 0	74·0	23·0	..
8	"	2	14·45	3·4	79·0	81·0	15 0	..
8	"	3	12 75	5·4	78 8	71·0	14·0	..

COKE FOR WATER GAS MANUFACTURE.

In considering what degree of reactivity is desirable in coke for water-gas manufacture, emphasis has often been laid upon the need for a high degree of reactivity towards steam during the gas-making run. It is most probable that coke possessing this property is also highly reactive towards carbon dioxide during the air blow. Such reactivity results in thermal loss due to the formation of carbon monoxide; and having regard to the relative values of the coke as used in the generator, and of steam derived from waste-heat boilers, breeze-fired boilers, or engine exhausts, it appears that this subject is worthy of reconsideration.

We have not been able to secure any new experimental data upon the relative merits of reactive and unreactive cokes for

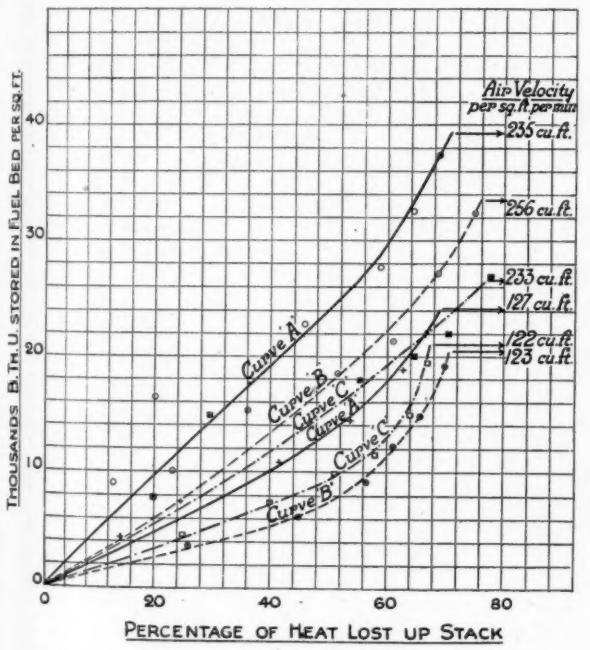
water gas manufacture, but we have drawn certain deductions from the data published recently in the report of the Carbonization Committee of the American Gas Association. The work of this Committee, which, it is suggested, deserves wider publicity than it has been given hitherto in this country, included an examination, in an experimental water gas generator, of several cokes prepared on an industrial scale from the same



Fuel No. 8. 8 in. Stove.

Fig. 13.

kind of coal in different types of carbonizing plant.* During air blows, at different predetermined rates of air passage, spot samples of gas were taken for analysis. From these analyses the distribution of heat as between the sensible heat of the



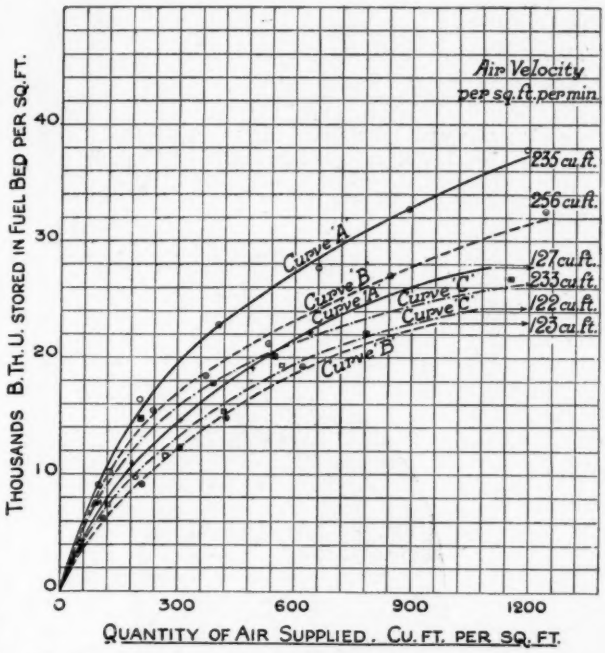
Water Gas Tests. A. Horizontal Retort Coke. B. Vertical Retort Coke. C. Coke Oven Coke.

Fig. 14.

fuel bed and the total heat of the blow gases was calculated for definite time intervals, and the results were compared on a time basis.

For practical purposes, however, the more important consideration is the distribution of heat when a given quantity of sensible heat has been stored in the fuel bed in readiness for the subsequent decomposition of a given quantity of steam. We have calculated the percentages of the total heat of the coke burnt (during the blow) which is lost as sensible and potential heat in the blow gas going up the stack, and also the quantities of air supplied, and have plotted the values against the quantities of sensible heat stored in the fuel bed per sq.ft. of grate area. Figs. 14 and 15 give the data in respect of each of three cokes at the lowest and highest air velocities employed. The curves show :

(1) That at approximately equal air velocities there is less loss of heat in the blow gases when using coke-oven or horizontal retort coke than when using vertical retort coke. This is due mainly to the lower reactivity of the harder coke, of which there is ample evidence in the report, resulting in the formation of less carbon monoxide.



Water Gas Tests. A. Horizontal Retort Coke. B. Vertical Retort Coke. C. Coke Oven Coke.

Fig. 15.

(2) That with any given coke there is less loss of heat in the blow gases when the air velocity is high. Herein lies one of the explanations of the known higher efficiencies when using high blast pressures on water gas generators.

Thus there appears to be good reason for concluding that the coke which is most reactive towards steam is not necessarily the most suitable for water gas manufacture. A non-reactive coke is desirable for thermal efficiency during the air blow because endothermic reaction is minimized. At the same time, a low apparent specific gravity is desirable because the open structure permits of ready heat interchange between the coke and the gases passing through it. Furthermore, with a non-reactive coke there is necessarily a more uniform distribution of heat in the fuel bed.

As indicated above, the respective values of steam and of coke, in addition to the more obvious factors such as ash content and size, will determine the choice of coke. It is possible that the true significance of the reactivity factor will not be appreciated until the respective relationships between steam and carbon dioxide reactivities and temperature are known over the whole temperature range of the fuel bed.

The experimental work described in this paper was carried out in the laboratories of the Gas Light and Coke Company.

An extract from a paper entitled " The Behaviour of Carbonized Fuels in the Open Fire-Grate," by Margaret F. Bligh, B.Sc. (London and Leeds), and H. J. Hodsman, M.B.E., M.Sc., F.I.C., will be published next week, together with the discussion on the three papers dealing with coke at the conference.

Manchester Regional Gas Industrial Council.—The annual meeting of the Manchester Regional Joint Industrial Council for the gas industry was held at Liverpool on Tuesday, March 1, prior to which an interesting visit to the Linacre Works of the Liverpool Gas Company was made by the members of the Council, at the kind invitation of the Chairman (Alderman Wade Deacon) and Directors of the Company. Lunch was provided at the Exchange Hotel by the Company. After this, the annual meeting was held, at which hearty appreciation of the day's proceedings was unanimously voiced. The Chairman of the Council is now Mr. C. E. Ross, and the Vice-Chairman Alderman F. S. Phillips, J.P., of Salford. Mr. J. H. Sillitoe, Secretary of the Manchester Corporation Gas Department, and Councillor J. Williams, J.P., are Joint Secretaries to the Council. It was noted in the report that the cordial relations existing between the employers' and the employees' sides have been well maintained. The Council recorded with regret the death of Mr. F. A. Pye, a valued member of the Executive Committee.

* Haslam, Ward, and Boyd, Proc. Amer. Gas Assoc., 1926.

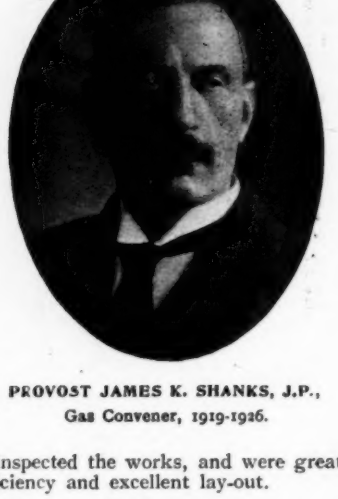
EXTENSIONS AT DENNY AND DUNIPACE.

INSTALLATION OF GLOVER-WEST VERTICAL RETORTS.

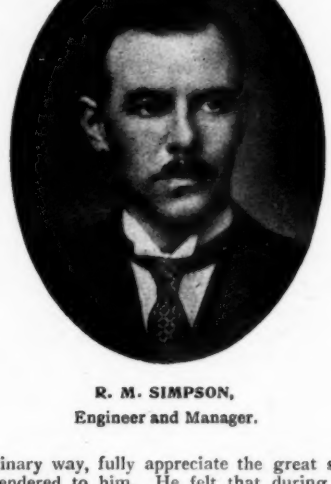
An interesting ceremony which marked an important stage in the progress and development of the public services of the Burgh of Denny and Dunipace, Stirlingshire, took place on Thursday afternoon, March 3, when the new Glover-West vertical retorts recently erected in connection with the extension of the Burgh's Gas Department were formally inaugurated and inspected.

At the invitation of the Provost, Magistrates, and Councillors of the Burgh, representatives from practically all the public authorities in Stirlingshire, in addition to gas engineers and managers from all over Scotland, were in attendance, making a company of over 100; and they were given a cordial welcome by Provost Shanks, who expressed the pleasure it gave him and his colleagues on the Town Council to see such a large gathering.

The first part of the proceedings was undertaken by ex-Provost Lochhead, who set the conveyor in motion. Provost Shanks then charged a retort, after which ex-Bailie Sawers, the Convener of the Gas Committee, discharged a retort. The visitors then inspected the works, and were greatly impressed with their efficiency and excellent lay-out.



PROVOST JAMES K. SHANKS, J.P.,
Gas Convener, 1919-1926.



R. M. SIMPSON,
Engineer and Manager.

LUNCHEON.

After the inauguration and inspection, the company adjourned to the Masonic Hall, Denny, where lunch was served in celebration of the occasion. Provost Shanks occupied the chair, while ex-Bailie Sawers acted as croupier.

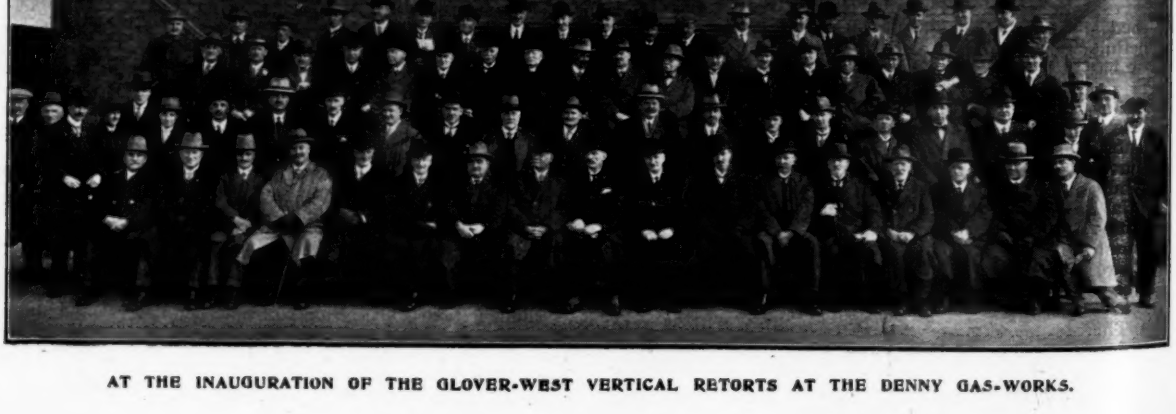
After the Loyal Toast had been honoured,

Bailie GILLIES proposed "The Imperial Forces." In the course of his remarks he congratulated all connected with the gas-works on the magnificent plant they had inspected that day. The manner in which all the work had been carried out reflected great credit both on the contractors and on the Gas Manager. He was Convener of the Electricity Department, which might be thought to be in some respects in opposition to the Gas Department; but he was as keen as any member of the Town Council to see the gas undertaking a success.

Colonel ALAN STEIN responded.

Alderman F. J. WEST, C.B.E., M.Inst.C.E., of Manchester, proposed the toast of "The Provost, Magistrates, and Councillors of the Burgh of Denny and Dunipace." It was not his intention, he said, to refer to the history of the Burgh, or to endeavour to trace its industrial and commercial development, except to remark that it was interesting to know that the late Ex-Provost Shanks, the father of the present civic head of the Burgh, was Chairman of the Denny Gas Consumers' Company when the works were acquired by the Town Council. Ex-Provost Shanks was Provost from 1882 to 1888, and Convener of the Gas Committee from 1887 to 1900. It was noteworthy that his son, the present Provost of the Burgh, was Gas Convener while the reconstruction and extension of the gas-works now being inaugurated were being carried through. The representatives of the town were to be congratulated on the great asset they had in their gas undertaking. One of the great assets which this country possessed to-day was the whole-hearted public service rendered by its public representatives. He knew of no country (and he had travelled in many) where the public representatives were more whole-heartedly disinterested, doing the best they could for the ratepayers of their respective towns in Great Britain. He had ample opportunity in his travels abroad of comparing municipal government in this country with that of the cities abroad. He was prepared to say that, in many respects, the government of the public services of Great Britain had many advantages over all others. Proceeding, Alderman West said he felt that the man-in-the-street did not, in the ordinary way, fully appreciate the great services the gas undertakings rendered to him. He felt that during the recent regrettable coal dispute the gas undertakings had gone on so steadily, and rendered service so unobtrusively, that the lessons of the strike had not been fully driven home. During the whole period practically every gas concern in the country continued its service without any interruption whatever. Denny, like all other places, had supplied gas regularly and steadily to the inhabitants; and though they might have to pay, for a short time, a little more for the gas, he thought that, despite this, they had not realized the great advantage that the gas industry had been to industry generally, and to the inhabitants, in supplying them with full heating and lighting during a time of great national anxiety. Concluding, he congratulated the ratepayers of the town on the success of their gas undertaking. He coupled with the toast the names of Provost Shanks and Ex-Provost Lochhead.

Provost SHANKS, in the course of his reply, said he fully appreciated the compliment paid him in associating his name along with that of Ex-Provost Lochhead in the toast so ably proposed by Alderman West, and so enthusiastically responded to by all present. They were all very proud of the town of Denny. They were fortunate in having a great many industries in and around the town. Though he had been a member of the Denny Town Council since 1908, it



AT THE INAUGURATION OF THE GLOVER-WEST VERTICAL RETORTS AT THE DENNY GAS-WORKS.

was not until the year 1919, when he became Convener of the Gas Committee, that he realized the importance of his position as a Town Councillor. At that time their output of gas was 26 million c.ft. per annum. They were pressing their plant to its fullest capacity, while the demand was growing greater and greater. Their storage capacity was only 55,000 c.ft. The first thing that Mr. Simpson, their Gas Manager, proposed was the laying-down of ample purifying plant. Mr. Simpson, who was a most energetic and capable engineer, designed that plant. They purchased a gasholder from the Government at East Fortune. They then got new and ample condensing plant, a railway siding, and a Glover-West vertical retort plant. They were thoroughly satisfied with their bargain. It was a good job. He had to express their regret at the absence of Mr. Cecil Poulson, the Contractor's Engineer. Mr. Poulson had passed through a very serious illness; and they wished him a speedy recovery. The Burgh of Denny was now supplying gas over an area of more than 4 sq. miles; and this year they expected their sales to reach 60 million c.ft. Their outstanding loan debt on the gas-works was only £36,190, or £600 per million c.ft. made.

Ex-Provost LOCHHEAD also replied. He said that in the matter of supplying gas the Town Council had looked ahead. When they took over Dennyloanhead, they increased the output from 14 million c.ft. to 28 millions, and reduced the price from 3s. 9d. to 3s. 1½d. per 1000 c.ft. They then took over Bonnybridge, which this year would increase the output to 60 million c.ft. This enabled them to go in for vertical retorts and modern equipment. To meet competition, a gas department had to be up-to-date.

Ex-Bailie SAWERS, Convener of the Gas Committee, submitted the toast of "The Contractors." He observed that the plant was a credit to the firm of West's Gas Improvement Company and their Engineer, Mr. Poulson. The practical results had exceeded the guarantee, and far surpassed their expectations. The Gas Manager's monthly reports were a source of gratification to the Town Council; and the consumers were satisfied. He coupled the toast with the names of Alderman F. J. West, and Mr. Ronald B. Glover.

Alderman WEST thanked all for the response to the toast.

A PRESENTATION.

Mr. RONALD B. GLOVER said he had had the privilege of being closely associated with the Denny undertaking from the first day Mr. Simpson had discussed matters with him in Denny. During the whole of the period they had had an excellent and happy association. Mr. Simpson had told them what he wanted, and they endeavoured to put before him what he stated he required. The result of their combined work had been seen that day. On behalf of his colleague, Mr. Poulson, he would like to thank the Provost for his kind remarks. Mr. Poulson had shown excellent capabilities, and had put his best into all the work. It was his (the speaker's) duty to make a small presentation to Provost Shanks and to Ex-Provost Lochhead. His firm thought it appropriate that they should have some memento of the opening of their reconstructed gas-works. He had pleasure in presenting each with a solid silver salver. (Both gifts were suitably inscribed and bore an engraving of a Glover-West vertical retort.)

Provost SHANKS and Ex-Provost LOCHHEAD returned thanks for the gifts.

Bailie LONEY submitted the toast of "The Gas Industry." Like many other good things, he said, the gas industry owed its origin to a Scotsman. When electric light came, many people thought the days of gas were numbered. He could remember when a member of the Town Council opposed the erection of a new gasholder in 1899, because he thought gas would soon be a thing of the past. This gentleman would be surprised, if he were alive, to see the great changes in the gas-works, and to learn that the output of gas had increased fully fourfold since then. No doubt electricity had, to some extent, ousted gas as an illuminant, but the result had been merely to spur gas engineers to greater invention and activity. About twenty years ago, in their district, gas was used solely for lighting. Now gas was employed for cooking in nearly every house. The use of gas for heating was also greatly extending. Gas fires had been introduced into almost all the houses recently erected by the Town Council, and they had also been fitted into a great number of other houses. It was to be hoped that the increasing use of gas fires would, to a considerable extent, cure the smoke evil. At the same time, they all liked to see open fires in living rooms; and perhaps the smoke nuisance would be solved by the production of smokeless solid fuel by the gas industry. He coupled with the toast the name of Mr. James Bell, of Dumbarton, the President of the North British Association of Gas Managers.

Mr. BELL remarked that in this country to-day they could not point to a more prosperous or progressive industry than the gas industry. It was going on from strength to strength, despite all they had heard about the Electricity Commissioners putting up super-power stations for the reduction of electric current to a penny per unit. They would be glad to have it at that figure. His cost him much more. As a fuel there was nothing finer than gas. Through the efforts of the "B.C.G.A." the demand for gas was going up by leaps and bounds, simply because they were taking steps to see that the public knew all about its many advantages. There were vast fields yet to conquer in the industrial sphere; and no doubt gas would be able to meet the needs of industry.

The proceedings terminated with the toast of "The Chairman," proposed by Mr. J. W. NAPIER, of Alloa.

The history of gas manufacture in Denny prior to 1845 is not definitely known; but about that year the Denny Joint Stock Gas Company was formed. They, however, appear to have failed to give satisfaction to their consumers, with the result that in 1861 the Denny Gas Consumers' Company, Ltd., came into existence, with a capital of £2500, subscribed mainly by consumers. In 1886 the Burgh Police Commissioners acquired the works from the Company, at an agreed price of £5500. Mr. John Potter Scott was Manager when the works were taken over, and continued to be so until 1888. Mr. John McDonald was then appointed, and held office until 1921, when he retired after 33 years' faithful service. Mr. Robert M. Simpson, the present Engineer and Manager, was appointed in 1921.

DEVELOPMENT OF THE UNDERTAKING.

It is learned from the illustrated brochure that the Police Commissioners, on taking over the concern from the Company, proceeded to erect a new retort house (which is now the coal store), and installed a set of purifiers. The latter were dismantled in 1922, when enlarged purifiers were installed. No further alterations of note were made from 1887 until 1900, when a new gasholder of 55,000 c.ft. capacity, with a cast-iron tank, was erected.

In 1912 the area of supply was extended to the villages of Dennyloanhead, Longcroft, Haggs, and Banknock, involving about 2 miles of high-pressure main, a governor house at Dennyloanhead, and over 2 miles of distributing mains. In order to develop the district rapidly, the Town Council fitted for gas almost all the houses in the district. The existing exhauster house was built at the same time; and 6000 c.ft. per hour Waller compressors and 15,000 c.ft. per hour Waller exhausters were installed in duplicate—one set of each being steam driven and the other gas driven.

A scheme for the improvement of the works was considered in 1914; but, with the exception of putting down a 250,000 c.ft. Livesey washer and a Holmes scrubber of the same capacity, the scheme was delayed owing to the war. Immediately after his appointment in 1921, Mr. Simpson reported as to the plant which was required to put the works into a satisfactory condition; and the Town Council resolved to proceed with the improvements suggested, commencing with the purifiers. Four purifiers, 15 ft. square by 5 ft. deep, arranged in a square with a connectionless valve, were erected by Messrs. Robert Dempster & Sons, Ltd., of Elland. The concrete foundation was prepared by the gas-works staff. In November, 1922, a two-lift spiral-guided gasholder of 250,000 c.ft. capacity, with a steel tank which had been erected by Messrs. Clayton, Son, & Co., Ltd., of Leeds, for the Government, at East Fortune Aerodrome, during the war, was purchased from the Government Disposal Board and satisfactorily dismantled, transported, and re-erected on a site adjoining the works by Messrs. Clayton; the concrete foundation being prepared by the gas-works staff.

ACQUISITION OF THE BONNYBRIDGE UNDERTAKING.

The advisability of introducing up-to-date carbonizing plant had been considered from time to time; but the annual make of gas was deemed insufficient to justify the capital outlay. In 1923 an opportunity of acquiring the Bonnybridge undertaking presented itself, and the Town Council authorized Mr. Simpson to enter into negotiations with the proprietors, Messrs. Smith & Wellstood, Ltd. A satisfactory price having been agreed upon, the Town Council resolved, in February, 1924, to purchase the undertaking.

A 4-in. high-pressure steel main was laid from the existing high-pressure main at Head of the Muir, via Drove Loan, to Loanfoot in Bonnybridge, where a governor house was erected, and governors provided by Messrs. Peebles & Co., Ltd., of Edinburgh, were installed. From the governor house an 8-in. low-pressure steel main was laid to The Toll, and connected there to the existing mains. Thereafter the Bonnybridge Gas-Works were dismantled; only the gasholders being retained. A year later the whole of the Bonnybridge mains were renewed.

RECONSTRUCTION AND IMPROVEMENT SCHEME.

Between 1924 and 1926, the Town Council, in view of the larger field for the sale of gas afforded by the acquisition of the Bonnybridge area, which, it was realized, was capable of considerable development, considered proposals submitted by Provost (then Bailie) Shanks (Convener) and Mr. Simpson for the reconstruction and better equipment of the works, including the installation of vertical retorts, waste-heat boiler, condenser, additional compressing plant, and the construction of a railway siding, &c. Plans and specifications were prepared by Mr. Simpson, who superintended the carrying out of the work. A tubular condenser of 750,000 c.ft. daily capacity and a steel condensing main were erected by Messrs. Clapham Bros., of Keighley, during the summer of 1925, and brought into use at the same time as the vertical retort installation. The foundation for the condenser is on the same level as the roof of the new tar and liquor well, thus permitting the condensates from the condenser to flow into the well without pumping. The existing engine house was extended during the autumn of 1925, and a Bryan-Donkin compressor, to pass 12,000 c.ft. per hour at 5 lbs. per sq.in. pressure, at 115 revolutions per minute, was installed.

GLOVER-WEST VERTICAL RETORTS.

The installation of Glover-West vertical retorts for the continuous carbonization of coal at these works consists of one setting of eight retorts arranged in four sets of combustion

GENERAL VIEW OF THE WORKS.

chambers. Each retort measures 33 in. by 10 in. at the top, and is approximately 21 ft. long.

The retort house building is of the steel-frame type, panelled with brickwork. This brickwork is perforated in suitable places for ventilation. Light is admitted through roof glazing and vertical glazing in the non-producer side frame. The roof covering consists of corrugated asbestos sheeting. Sliding doors have been fitted to all openings at the ground level. One gable has been built on top of the side wall of the existing retort house.

The coke storage consists of a steel hopper arranged in the retort house, with outlets for screened coke for retort and producer feed. The capacity is equivalent to 48 hours' discharge of coke from the installation. The main outlet is carried outside the building, and leads to trucks on the adjacent railway line. The retort feed outlet is provided with sack-filling apparatus. Coke is thus readily loaded mechanically into road vehicles or railway wagons. What little manual handling there may be, is confined to the retort house. The coke is wheeled in a barrow from the bottom mouthpieces to the yard or to the shoot in the floor leading to the lip-bucket conveyor, by which it is raised to the coke hopper.

A West-Galloway boiler, of the vertical water-tube type, with superheater coil, which has an evaporative capacity of 750 lbs. of water per hour at normal temperature and pressure, supplies ample steam, at 500° Fahr. and 100 to 120 lbs. pressure, for general purposes. This boiler utilizes the waste heat from the setting, thus completing the cycle of heat conservation.

The engine house is arranged in a corner of the existing retort house, and accommodates the gas engines for the extractor driving gear and the steam engine for the coal-plant drive. The tar pumps for circulating tar and liquor to the gas collecting mains are so connected that they may also be used for pumping tar and liquor from the storage wells to tank wagons on the railway.

The coal is received by rail in hopper-bottomed wagons, and dropped into a receiving hopper through a large-mesh grid, on which the biggest pieces may be broken. The hopper terminates in a shoot leading to a West coal breaker of 25 tons hourly capacity, which reduces the coal to pieces of a size suitable to the plant. The broken coal is led by means of a shoot to a West lip-bucket conveyor also designed to handle 25 tons of coal per hour. A by-pass shoot is arranged to carry "smalls" direct from the receiving hopper to the lip-bucket conveyor. This conveyor consists of buckets placed upon an endless chain, which, in passing down into a pit arranged to accommodate the receiving hopper and coal breaker, is fed either with coal as mentioned above or with coke by means of a shoot from the retort house floor. Coal or coke fed to the buckets in the pit is raised to, and delivered into, either the coal bunkers or the coke storage hopper. When the bunkers are full, the excess coal overflows into a shoot leading through the roof of the coal store, into a corner of which it may be directed by means of a light steel shoot. The plant is so arranged that a lift may be installed, at some future time, in the coal store to take coal out of stock.

The installation has been designed for convenient extension. The coal and coke handling plant has been taken well above the retort bench, so that not only can the conveyor be readily arranged to feed further retort benches in the same line, but retorts of the larger model can be installed at very little additional cost.

Results.

(Period—Eight days, from 3 p.m., 3rd to 11th of February, 1927.)

Coal—Hirstrigg Treble Nuts.	
Proximate analysis:	
Moisture	2·90 p.ct.
Volatile combustible matter	34·50 ,,
Fixed carbon	55·90 ,,
Ash	6·70 ,,
Calorific value	14,000 B.Th.U. per lb.
Ultimate analysis (dry coal):	
Ash	6·90 p.ct.
Carbon	77·43 ,,
Hydrogen	5·25 ,,
Sulphur	0·70 ,,
Nitrogen	1·57 ,,
Oxygen	8·15 ,,
Gas—Make per ton	23,986 c.ft.
Calorific value (average)	417·8 B.Th.U.
Therms per ton	100·2
Coke—Make per ton	12·75 cwt.
Ash content	12·70 p.ct.
Tar—Per ton of coal	19 23 gallons
Ammonia—10 oz. liquor per ton	43 gallons

(Signed) R. M. SIMPSON,
Engineer and Manager.

Annual Report of the British Legion.

In the annual report of the British Legion, it is mentioned that the Officers' Employment Bureau, formerly under the Ministry of Labour, is now part of the machinery of the Legion; its function being to find employment for ex-officers and others of similar educational attainments. For the nine months ended Sept. 30, 1926, the Bureau was directly instrumental in placing 423 ex-service men in employment, while it gave 2625 introductions. During the same period 5536 applicants were interviewed. The complete re-absorption of disabled ex-service men into the industries of the country has been one of the Legion's greatest cares. The latest returns show that there are about 27,500 firms on the King's National Roll, employing approximately 375,000 disabled ex-service men. The King's Roll National Council has continued its efforts to secure the enrolment of public utility companies, such as electricity and gas; and out of a total of 548 such companies, 344 are now on the Roll. The number of disabled ex-service men registered at Employment Exchanges as being in search of employment is 28,676, compared with 32,350 in December, 1925.

Society of British Gas Industries.—The annual general meeting of the Society will be held at the Hotel Cecil on Thursday, May 26, under the presidency of Viscount Ednam, M.C., D.L. The annual dinner will take place in the evening. The programme will be announced later.

Tankless Gasholders.—The Gas Light and Coke Company have two tankless gasholders under construction—one for Staines, with a capacity of 1,500,000 c.ft.; and the other for Woodford, with a capacity of 1,000,000 c.ft. After negotiations with Messrs. John le Boutillier, orders for these holders were placed respectively with Messrs. Edward Cockey & Sons and Messrs. R. & J. Dempster, Ltd.

THE CASE FOR THE ISOLATED STUDENT.

By ARTHUR COE, of Halifax.

It has been suggested that it will probably be found that the gas output of the 260 provincial undertakings which have been estimated to be the maximum number which can possibly be served by the Education Scheme in its present form represents 80 to 90 p.ct. of the total gas output for the kingdom, and that probably this same percentage represents roughly the number of potential students.

First of all, if we are to accept this method of assessing the efficacy of the Scheme when the London area has been supplied, one-third of the number of potential students have been provided for. The returns for the various examinations before the inauguration of the present scheme show that this assumption is absurd. In my figures, however, I have ignored the London Companies, as the scheme is ideal for this area. The difficulty is that the problem in the provinces requires a different solution.

Turning to the provincial undertakings, approximately 20 p.ct. of them may be catered for; and these, I find, represent approximately from 40 to 50 p.ct. only of the total gas made. It must be borne in mind that, out of the four undertakings assumed to be served by each of the prospective schools, three of them are very small works. So that the 910 undertakings isolated from the colleges represent not less than 50 p.ct. of the total gas made in the provinces. Viewing these figures, it is also necessary to bear in mind that, of these prospective 65 schools, it has not been practicable fully to recognize more than 20 as yet; and I am not aware that there has been any addition to this number during the past year. Rather the number has been lowered, owing to an insufficient number of students in several of the areas.

The following cases which have come to my notice bear out these facts. At Cambridge (772 millions) the standards of the local school are not sufficiently high, and the only chemistry classes available are those for pharmaceutical students, and arranged by the Pharmaceutical Society. At Blackpool (1012 millions) the same applies with regard to standards; and the Technical School at Lytham, 15 miles away, cannot make good the deficiency. At Hereford (222 millions) the nearest school is 26 miles away; travelling facilities make regular attendance impossible, and the travelling expenses for a complete session would not be less than £15.

The Manager of the gas-works at Newtown writes to say that the nearest school is at Cardiff, 90 miles away. A 60-mile radius from Newtown should yield anything up to 30 first-class cases of hardship.

A student at Long Eaton (285 millions) has his nearest technical school at Nottingham, 7 miles away. Travelling facilities are bad.

At Shrewsbury (273 millions) the training in the ancillary subjects is not sufficiently high to meet the requirements for the Higher Examination.

At Poynton (10 millions) one of the students is 24 miles away from a technical school, and travelling facilities make attendance impossible.

A student at Ringwood (18 millions) gives his nearest technical school as Bournemouth, 15 miles away; and travelling facilities preclude regular attendance.

A student at Retford (126 millions) is 34 miles away from the nearest technical school at Sheffield.

A student at Chesterfield (394 millions) informs me that the technical school there does not take the subjects to the standard required for the Higher Examination.

I learn from Malton (75 millions) that the nearest useful technical school is York, 20 miles away. There is doubt as to the standard being that required for the Higher Examinations, and the return fare is 5s. 4d., making the journey impossible for a junior, on the grounds of expense.

The nearest technical school to Aberbeeg is Newport, 15 miles away. The journey occupies 1 hour each way, and facilities are none too good.

A student at Tonbridge (205 millions) writes to inform me that for two years he travelled to London when working for the Higher Examination in gas engineering, at an expense of £17 10s.

We now come to the interesting class of articled pupils with constructional engineering firms who cater for the gas industry. These students are, as a rule, sons of gas engineers. We have three students at Messrs. Drakes, Ltd., all of whom are in the interesting position of being unable to attend regularly any school, owing to being moved periodically to various parts of the country. Their knowledge of the ancillary subjects is sufficient to qualify them, I think, for the Ordinary Examination, but they cannot possibly obtain their knowledge of the ancillary subjects required for the Higher Examination. It is interesting that in no case will they return to a district where facilities exist. I venture to suggest that 30 to 50 clear cases of hardship can be obtained by simply circularizing constructional engineering firms. The point here is that their studies should run concurrently with the training they are receiving.

We have a student at Portsmouth (2375 millions), and he is unable to get any further with the ancillary subjects owing to the discontinuation of classes in the ancillary subjects, because of an insufficient number of students. He has no alternative but to continue his work for the examinations of the City and Guilds of London Institute.

A student at Alfreton (34 millions), 15 miles from Derby, who took the examinations of Gas Supply Practice of the City and Guilds of London Institute last year, cannot get any further with his studies, as the nearest technical school is at Derby or Nottingham, 15 miles away. To attend at Derby would cost him 2s. per journey, or 6s. per week, while to attend at Nottingham would cost him 1s. 8d. per journey and a three-mile walk. I might add that before he commenced with us he was sufficiently keen to take a course with the International Correspondence School in mathematics and science, extending over about three years.

A student from Jersey (240 millions) cannot make any further progress than the examinations of the City and Guilds of London Institute, as there is no technical school within 100 miles. He has had a secondary and grammar school education.

A student at Sandown (40 millions), Isle of Wight, would have to travel to Portsmouth, leaving work early every afternoon, staying overnight, and returning the following morning an hour late, to obtain instruction in the ancillary subjects.

I am told that at Exeter (614 millions) the only evening classes in the requisite ancillary subjects are in building construction; and there is a question as to standard.

From Sherborne (60 millions), Dorset, I learn that there is no technical school within convenient travelling distance.

At Ramsgate (252 millions) the standard achieved is equivalent to Matriculation, which is not high enough for the Ordinary Examination.

Worthing (311 millions) is 12 miles from the technical school at Brighton.

A student at Stourport (36 millions) cannot attend the nearest technical school, which is at Birmingham, owing to having to leave his work early in the afternoon, apart from the heavy expenses of travelling. He is attending the School of Science at Kidderminster, but cannot take all the subjects required, as some of them occur on the same evening. This is rather an interesting point. Presumably he must attend a further two years to get these.

From Macclesfield (301 millions) I learn that there are schools at Stockport and Manchester. Providing that the student is allowed to leave his work half-an-hour before the usual time, after walking 1¾ miles he can attend, and he would get home at 11.30 p.m. He asks if this is conducive to efficiency at his work. His travelling expenses would be 5s. 6d. per week. Frankly he cannot afford it. If he attended Manchester, his expenses would be 10s. 3d. per week, but he could not take the full course, as several of the subjects are taught on the same evening.

A student at Clacton-on-Sea (92 millions) must needs travel to Colchester, 16 miles away, and then stop short before the standard required for the Higher Examination is reached.

A student at Cheltenham (526 millions) writes to say that to attend the evening school there "is a waste of time" in any subject save mathematics. The laboratory equipment is poor, and in physics and chemistry they do "the same work year after year."

Several students of ours in Wicklow, Ireland, have as their nearest technical school Dublin, 30 miles away. Travelling facilities are "hopeless," as they would have to stay overnight in Dublin, and to arrive there at 7 p.m. they would have to leave Wicklow at noon.

A working manager writes to say that the nearest technical school is Northampton, and with existing travelling facilities he would arrive half-an-hour after the classes had commenced. Evidently the facilities here would be all right if he could persuade the railway companies to run a special train for him.

A student at Scarborough (522 millions) writes to say that the standard of the local technical college is too low to be of any use to him.

At Guernsey (185 millions) there is no school on the island. At Sittingbourne (97 millions) the nearest school is 11 miles away, and the return train journey must be commenced before the classes end. At Rothesay (147 millions) the student requires to go to Greenock, leaving at 5 p.m., travelling by train and steamer, staying at Greenock overnight, and returning the following morning at 10.30, at a cost of 15s. per lesson.

We have several students at Shanklin (50 millions) in a precisely similar position, as they would have to travel to Portsmouth.

The Spalding Gas-Works (80 millions), Lincs., is 40 miles away from the nearest technical school. I believe there are two technical schools available for the whole of Lincolnshire, so that here we could find roughly another 20 cases of hardship under the Scheme.

It is impossible for a student at Wells, in Somerset, to attend

the technical school at Bath, owing to the inadequate travelling facilities.

The technical school at Inverness is unable to cater to the requisite standard. The student must attend Aberdeen, but the distance makes this a hopeless proposition.

I have a growing collection of cases where students are able to obtain facilities, but the travelling involved makes the task not merely arduous, but extremely discouraging, for they labour under the fact that candidates for no other profession are required to put up with such conditions. Naturally they cannot see why candidates for the gas profession should be singled out for this treatment. I might add that 90 p.ct. of the above cases relate to young men who have had a secondary school education; also that the undertakings quoted represent at the moment an average of two prospective candidates each.

The assumption that the industry can be catered for on the grounds of gas output is therefore unsound, apart altogether from the vital factor which I wish now to consider. If we were not considering a professional scheme, there might be more truth in the assumption that the number of potential students varies directly with the size of undertaking, as this is roughly the case (say) in the number of fitters employed. But the non-professional classes have been provided for fully in the new examinations of the City and Guilds of London Institute; and, be it noted, in this section of the Scheme, unless a local school exists which can supply the ancillary subjects to the standard required, a student is at liberty to obtain this knowledge when and where he pleases. Turning to the professional section, we have in the majority of cases simply a manager or two or three assistants who are really concerned. In other words, the very fact that it is a professional scheme precludes any possibility of sufficient numbers of students coming forward in any save the largest areas. It is interesting to reflect that the greatest gas engineers of the past have graduated in the small works.

These facts prompt the question, "Why should the regulations of the City and Guilds of London Institute Examinations under the Scheme provide full facilities for the isolated student in the ancillary subjects, while the professional section ignores this problem?" It is noteworthy that the Scheme at present operates to eliminate candidates for the profession by lack of facilities, instead of, as in every other profession, by lack of ability to pass the tests. Apart from this absurd position, the elimination by lack of facilities is not conducive to higher standards. In fact, it is impossible to raise the standard beyond that attained by the least of the approved schools. Surely the standards in the main subjects can be made sufficiently high to ensure elimination by lack of ability only.

The position in the provinces may well give rise to the remark that the Scheme might have been designed to assist the railway companies.

Southern Association of Gas Engineers and Managers.—The annual general meeting of the Association will be held on Wednesday, March 30, at the Hotel Cecil, Strand, W.C., at 2.15, and will be preceded by luncheon at 12.30. Mr. Thomas Hardie, M.Inst.C.E., will deliver his Presidential Address; and there will be a paper on "Modern Water Gas Plant," by Mr. C. A. Cunnold.

Scope of the "Feuerfest."—The Editor, L. Litinsky, of our contemporary "Feuerfest" (published by Otto Spamer, of Leipzig) informs us of important extensions in the scope of the paper. As its title implies, it has, since its inauguration two years ago, been devoted to technical and news matter concerning refractory materials. In view of the essentially close connection between these and industrial ovens of all kinds, the size of the paper is to be extended, and the additional space will be definitely used to include matters pertaining to the construction and the economics of coke-ovens, gas-works settings, blast-furnaces, &c.

New "B.E.S.A." Specifications.—The British Engineering Standards Association have just issued specifications for zinc oxide ready-mixed linseed oil paint and tinted zinc oxide ready-mixed linseed oil paint. They contain clauses regulating the composition, together with standard reception tests, for the purchase of these materials, and appendixes giving methods of carrying out the tests. These specifications have been prepared at the request of the paint manufacturers by a Committee representative of both the buying and the manufacturing interests; and as in the case of all British Standard Specifications, they will be reviewed as experience of their working or progress in the industry renders it necessary. Copies of these two new specifications (Nos. 277 and 278, 1927) may be obtained from the "B.E.S.A." Publications Department, 28, Victoria Street, S.W. 1, price 2s. 2d. each, post free.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

Can Maintenance be Reduced?

Sir,—The recent conference on maintenance prompts me to ask this question; and I would venture to make a few suggestions which indicate that the answer is in the affirmative. In general the causes that render gas apparatus unsatisfactory are, apart from bad design, dirt and bad regulation. Dust will inevitably collect in gas burners owing to the amount of dust-laden air passed through them; but it does not follow that the amount of such deposit cannot be reduced. The replacement of gauze in lighting burners by a clay disc has resulted in the bulk of the dust, which previously collected on the gauze and caused so much trouble, passing through the burner. The nipple is another point prone to collect dust; but a little care in the design and positioning of the nipple will reduce the amount of dust deposited. In the same way a burner with a smooth interior free from projections will collect less dust, and be more efficient in every way, than one roughly made. Apart from burners the deposit of dust on other parts can be reduced by the elimination, as far as is possible, of all horizontally-disposed surfaces. In passing, I would ask why the geyser should not have its vast expanse of copper, which must be polished regularly or else look shabby, replaced by white enamelled steel. All these details are worthy of study with a view to improving the service provided by gas apparatus.

In my opinion, however, the greatest improvement would be effected by abolishing those snares and delusions, the gas and air regulators. I do not see on what grounds their retention is justified. They are useless for dealing with pressure variations; and except for correcting burner design, they are of very little use for compensating for variations in the quality or composition of the gas. They are, however, responsible for a good deal of dissatisfaction, and also for some of the noise created by gas burners.

It would appear that much better results could be obtained from burners of fixed proportions if they were made in two types—one to suit coal gas, and the other to suit a coal and water gas mixture. If I were told that the percentage of water gas varies, and that difficulties would arise on that account, I would reply that I am not aware that consumers are in the habit of readjusting their burners from time to time to suit the proportion of water gas being sent out, so that in this respect the position would not be any worse than it is to-day. I know of a cooker and four fires which have given good results for the past six years without adjustment, though they have worked on pressure varying from 1½ in. to 8 in., in two districts where the composition of the gas must have varied considerably. On the other hand, many instances could be given of what should be good installations—particularly lighting—which are ruined by bad regulation. Would electricity have had one fraction of the business it had if every lamp, radiator, &c., was fitted with two regulators? It would not. The carburettor as used on the motor-car is a sort of glorified gas burner, and in its modern form it is practically free from adjustments. The car manufacturers have realized that it does not pay to leave adjustments to unskilled persons.

I am aware that the South Metropolitan Gas Company have been showing the way with non-regulatable burners for years, with excellent results; and this makes it the more surprising that others have tolerated these regulators for so long. It would take time to effect a change, but I feel sure that in the end it would strengthen the position of gas, and simultaneously reduce the cost of maintenance.

H. Staniforth.

5, *Woodland Drive,*
Watford, March 4, 1927.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

Progress of Bills.

Coventry Corporation and Wallasey Corporation Bills: Read a second time, and committed.

Special Orders.

On behalf of the Hastings and St. Leonards Gas Company, a petition has been deposited against the Hastings Electricity (Extension) Special Order, 1927.

HOUSE OF COMMONS.

Progress of Bills.

Leeds Corporation Bill: Read a second time, and committed.
Farnham Gas and Electricity and Reading Gas Bills: Committed.

Continental Union Gas Company, Ltd.—The Directors announce that an interim dividend of 3½ p.ct., less tax at 4s. in the pound, will be payable on the 12th of April next on the preference stock, on account of the year ending June 30, 1927.

Issue of Stock at Leatherhead.—The Directors of the Leatherhead Gas and Lighting Company have instructed Messrs. A. & W. Richards to offer for sale by tender £20,000 6½ p.ct. redeemable preference stock, to be redeemed at par on April 1, 1937, the minimum price of issue being par. Tenders should reach Messrs. Richards, at 37, Walbrook, E.C. 4, not later than eleven o'clock on Thursday, March 17.

MISCELLANEOUS NEWS.

GAS REGULATION ACT APPLICATIONS.

SPECIAL ORDERS.

Bolsover Gas Light and Coke Company, Ltd.

To increase the share capital and borrowing powers; to make provisions as to dividends, and to make further regulations with regard to the supply of gas.

Manchester Corporation.

To enable the Corporation to borrow such further moneys as they may from time to time require for the purposes of their gas undertaking.

DECLARATIONS OF CALORIFIC VALUE.

Burnley Corporation.—475 B.Th.U., in substitution for 450 B.Th.U. (July 1.)

Thornton Urban District Council.—500 B.Th.U. (April 1.)

GAS INQUIRY AT BALLYMENA.

At an inquiry in Ballymena by Mr. JOHN BATES (Ulster Home Office) into the application by the Urban Council for (1) a Provisional Order to extend the limit imposed by the Ballymena Gas Order, 1920, on the price that may be charged by the Council for gas supplied to customers; and (2) a loan of £4000 to pay off an overdraft in connection with the gas-works, Mr. ALBERT L. M'CLELLAND, Town Solicitor, said that, though the Council were asking for a Provisional Order giving liberty to charge 10s. per 1000 c.ft. for gas, it did not necessarily follow that this would be charged. It was purely for a case of emergency. During the war period the Council were selling gas at 5s. when it was costing 8s., 9s., and 10s. to manufacture; and during the recent strike the Council were handicapped through not being able to charge what the gas was costing. The application for the loan of £4000 was made to meet the loss sustained during the strike.

Mr. J. CRAWFORD SHAW, Accountant, showed that in 1920, 1921, 1922, and 1926 there were deficiencies at the works, and that in 1923, 1924, and 1925 there were profits. The deficiency for the nine months ended March, 1926, amounted to £29,800.

Mr. BATES: Are you satisfied that the loan is essential?

Mr. SHAW: If the Council asked for what they might be entitled to ask so that the Gas Department would pay its way, they would be petitioning for £8000.

Mr. JAMES MORRISON, Gas Manager, observed that there was not the demand for gas of which the retorts were capable. In the winter, six out of eight were working, and in the summer two or three.

Mr. SHAW said that in a year in which there was a profit, the Council reduced the price of gas instead of keeping it up to get back to normal at the works.

Mr. BATES remarked that, if the demand increased, there was no doubt that the undertaking could be carried on with profit.

Mr. SHAW agreed.

IN DEFENCE OF TAR.

From the "Observer" for Feb. 20.

The danger to fish and all other sub-aquatic life from the washings from tarred roads can be avoided, it is stated, by the use of tar of a superior quality, and its application by suitable and careful methods.

Not more than 4 to 5 p.ct. of roads in the country drain directly into fishing streams. If it were found necessary, Mr. W. E. Cone, of the British Road Tar Association, said in an interview with the "Observer," actually to have a tar which could be used without any serious effect at all on these roads, it would be a comparatively simple matter to supply a material which would be perfectly innocuous.

"On the other hand," he said, "much of the trouble, to my mind, arises from the lack of knowledge on the part of some of the authorities who are responsible for carrying out road surface dressings in tar. Not only is the use of inferior tars often resorted to, but the surface tarring operations themselves are carried out in an inefficient manner.

"If tar of a sufficiently high viscosity is used, and its application is made under the correct conditions, suitably top-dressed with approved stone chippings, and the whole lightly rolled, the resultant surface is much less liable to any harmful reaction from rain than any inferior material used without this care.

"With good material and sufficient care in its application a surfacing is produced which is closely amalgamated with the existing formation of the road; and by the adhesiveness of the associated materials, the risk of pollution is greatly minimized, if not practically eliminated.

"Tar in itself contains the essential characteristics that give penetration and adhesion to any road surface. This, combined with the natural affinity that undoubtedly exists between differing kinds of stone and tar when in combination, adds considerably to its value, the understanding of which can be utilized to very great advantage for securing the best possible results in the surface dressing of roads.

"More attention than is often the case might be paid to the chemical constitution of the stone, as well as to the size; and if this is considered in the light of the absorption values of stone and tar, it is possible not only to strengthen the road, but to secure immunity against the pollution of fishing streams and 'bleeding' of the surface."

GAS-WORKS EXTENSIONS AT LLANDUDNO.

A public inquiry by the Ministry of Health, conducted by Mr. G. H. THISELTON DYER, M.Inst.C.E., one of the Ministry's Inspectors, was held recently at the Town Hall, Llandudno, into the application of the Llandudno Council for a loan of £23,800 for new carbonizing plant, £5000 for the purchase of gas meters and cookers, and £200 for the erection of a boundary wall.

Mr. CONOLLY (Clerk to the Council) said that in 1921 the Council called in Mr. J. C. Belton, of Chester, to act as Consultant Engineer; and they were advised by him that the existing retort house was not well adapted for economical methods of carbonization, and that there were abundant indications of weakness in the construction of the building. The urgency for the enlargement of the plant was evident from the fact that the make of gas had increased from 117,789,000 c.ft. in 1920 to 148,498,000 c.ft. in 1926—an increase of 26 p.ct. The present maximum daily output was 650,000 c.ft., and the minimum 400,000 c.ft.; and the new consumers averaged 98 per annum. During August last all the available carbonizing plant was working at full pressure; and the possibility of a breakdown, and consequent interruption in the supply of gas to the town, was a source of great anxiety to the Gas Manager and the Council.

Mr. F. DUXBURY (Gas Manager), reporting on the development of the undertaking, said that between 1921 and 1926 there were 450 new consumers. The capacity of the existing plant was approximately 700,000 c.ft. a day; and that of the proposed new plant would be 960,000 c.ft. a day. The existing retort house was erected 28 years ago.

There was no opposition; and after several members had impressed on the Inspector the need for the work to be put in hand as soon as possible, the inquiry closed.

THE ROMANCE OF A PIECE OF COAL.

The Secretary of the Eastbourne Gas Company (Mr. James S. Garrard), in a letter, says that some members of his staff spent a very pleasant evening recently with the local "Y.M.C.A." The immediate object was a lecture, with numerous exhibits, entitled: "The Romance of a Piece of Coal." The Secretary of the Association is a well-known local versifier, and subsequently he wrote a poetical précis of the lecture. The verses are as follows:

I took a piece of jet black coal,
Into my hand,
And bade it speak to me its Soul
Of Wonderland.
I looked into its coal black eyes
Till I could see
The wonders of the earth and skies,
Eternity.

I took a piece of living coal
In eyes of night.
I saw its spirit live and glow
In the fire light.
I saw rich tints of rainbow hue
Light up the night.
I saw brave tints that lived anew
In colours bright.

I took a piece of jet black coal,
(Once living tree)
I saw the world 'neath its control,
It whispered me:
I give you things you need each day,
Rose scents from tars,
With chemicals I hold me sway,
O'er future wars.

J. W. Hayes, M.B.E.

TRADE NOTES.

The "Nautilus" Coke Boiler.

The Nautilus Fire Company, Ltd., have published an illustrated booklet describing the advantages—which are many—of their "Nautilus" coke boiler, which increases in popularity daily. The pleasing appearance of this boiler is not the least of its attractions.

New Plant for Japan.

The Power-Gas Corporation, Ltd., of Stockton-on-Tees, have received intimation from their Japanese representatives of the acceptance of their tender for the second extension to the coal gas retort generator plant which they have supplied to the Yokohama Gas-Works. The original plant comprised two generators, each capable of generating 500,000 c.ft. of water gas per day from bituminous coal, with sulphate of ammonia recovery. The first extension consisted of a further two similar generators; and the installation is at present providing the whole town supply for Yokohama. The order just obtained covers a fifth generator unit of like capacity, and, as in the previous cases, has been secured in face of foreign competition.

Cheaper Gas at Birmingham.—The Gas Committee have decided to reduce the price of gas by 6d. per 1000 c.ft. after the March readings of the meters. Prior to the coal dispute, the price of gas in Birmingham for ordinary domestic supplies was 3s. 2d. per 1000 c.ft. In September, the price was advanced, by 6d., to 3s. 8d.; and in November, owing to the large purchases of foreign coal which had had to be made at high prices in order to maintain an adequate supply of gas, the price was further advanced, by 4d., to 4s. The reduction now to be made will bring the price down to 3s. 6d. per 1000 c.ft.

WANDSWORTH, WIMBLEDON, AND EPSOM GAS COMPANY.

ORDINARY GENERAL MEETING.

The Ordinary General Meeting of the Company was held on Tuesday of last week, at the Cannon Street Hotel, E.C.—Mr. Frank H. Jones (the Chairman) presiding.

The Secretary (Mr. C. W. Braine, F.C.I.S.) read the notice convening the meeting; and the report of the Directors and the statement of accounts for the year ended Dec. 31 were taken as read.

The Chairman: A year ago, I was a very foolish person when I was speaking to you, because I used these words: "We have coal contracts which will show a very considerable saving. Therefore we have every hope that the price of gas in Wandsworth will not have to go up." That was said on March 2 last year, when the prices of gas were: Wandsworth, 8·4d. per therm; Mitcham, 9·4d.; and Epsom, 10·6d. They are to-day 10d., 11d., and 12·2d. per therm respectively. I think this shows clearly how unwise it is for anybody to try to prophesy as to the price of gas. I am going to tell you something later on about the price of gas; but I am not going to prophesy again; I am going to give you facts.

Trouble in the Coalfields.

Early in March last year, you will remember, there was talk about trouble in the coalfields. Your Directors had got what we thought was a large stock of coal and oil together; and when the strike began at the end of April, we had material enough to enable us to go on making gas for the duration of the longest strike I knew anything about, which was the long strike of five or six years ago. We thought we were all right; but when June came, we, and other people who used coal in large quantities, had to ask ourselves what was going to happen if this strike should go on. We found ourselves menaced for a little while by the general strike. That did not worry us very much, because we knew we had the coal, and we never even troubled about whether our men would stick to their jobs. Early in May, I went down to our Wandsworth Works. These are our largest works, and, as you know, are situated on the Thames, and are the place at which our ships discharge. On one side of them we have a great electric power station; and on the other, one of the depots of the London County Council tramways. When I went down there, the men at these two places were all out on strike. We, again, did not worry about our own men, except on account of the very serious menace which threatened them owing to what was happening on the streets to people who were trying to do their duty. We have to transport coal for Mitcham and Epsom over our district, and also coke, which we sell in large quantities. The lorries went out of our yards and through the streets; and not one of the drivers of these lorries—and hundreds of tons of material had to be moved on some days—suggested that he would like another man on the lorry with him. This, too, in spite of the fact that for a long period our lorry drivers were working overtime night after night. I think you will agree with me that in this respect we were in a very happy position, because our geographical position was not a very pleasant one to start with. I could tell you many things about what happened in our district during that fortnight, and also during the long coal strike; but I am only going to tell you that at the end of the general strike, when the pay envelopes were handed out, we enclosed in each one a notice to the men, signed by the Chairman of the Company and the Chief Engineer—not presuming to thank them for having done their duty, but merely letting them know that the whole undertaking had run smoothly, and that there had been no trouble of any description of our making. I think that that is something which might be imitated in other places. ["Hear, hear."] I have often said that there is nothing peculiar about a gas undertaking which makes it possible to have really good understanding and common sense between all grades. Here was an example of an undertaking, not under easy conditions at all, which was able to go through that general strike without any trouble or worry at all so far as its own people were concerned.

Good Quality American Coal.

With regard to the year's working, up to June of this year we had done extremely well: and, if we could have had a balance-sheet and a general meeting then, we should have shown you a good increase in business, money on deposit at the bank, dividends paid, and very good working results. Although we had had two months of the coal strike, our coal stocks were still quite good; but we had to look round and make provision for the future. Very wisely, as it turned out, we came to the conclusion that we would get coal of a good sort, and not risk what we did in the previous strike. The South Metropolitan Gas Company were about to enter into very large contracts for coal from America of the highest quality. I went to Dr. Carpenter; and the result was that we were able to make arrangements with them to get similar coal. I want to say now that we are very much indebted to Dr. Carpenter, who sanctioned it, and to Mr. Frederick McLeod, who carried it through, for allowing us to make an arrangement which has been of the greatest benefit to this Company. As compared with all the companies that adjoin the Wandsworth Company, the amount per ton we paid for coal in 1926 was the cheapest, with the exception of the South Metropolitan Company, who did not have to send some to Mitcham and some to Epsom by road, as we did; and therefore I take this opportunity—as I am sure you would wish me to do—of letting the South Metropolitan Company know we are grateful to them for what they did. And now I want to thank somebody else. As I have said, we were relieved of the trouble of running about looking for coal; but we had to find someone who would pay for these large quantities of American coal, because when the coal began to come along our own deposit money drifted away like snow. Accordingly, we went to our bankers—Barclays Bank, Ltd.—and they practically said: "Go on, and do what you like." Therefore I wish to thank them for having made things much easier for us. I do not mind adding that your dividends will be posted to-night, and owing to the kindness again of Barclays Bank, they can be cashed to-morrow.

Increased Sale of Gas.

You will have seen from the report that there has been an increase of 6 p.ct. in the sale of gas. There has also been an increase in the capital of the Company of 3 p.ct.; and if you go a little deeper still, you will note an increase in the number of consumers of 3½ p.ct. Some of those present at this meeting will understand very well what that means. It means that we have increased our business with a very low rate of expenditure of capital, and it also means that the consumption of gas per consumer must have gone up, because we have increased our consumers by 3½ p.ct. and the sales of gas by 6 p.ct. I may add that I think this 6 p.ct. increase has "come to stay." Up to last Saturday—that is, for practically two months of the current year—the increase in the sales of gas for the whole undertaking has been 8·7 p.ct. That goes to show that people learned to use gas to a greater degree during the coal strike, and that they are continuing so to use it. The amount of capital expended is, of course, very low. We spent £39,000, and we did additional business to the extent of 950,000 therms. The amount spent on maintenance of our works, mains, and district apparatus generally is larger in most cases than in the previous year. It is quite as high as is generally the case, and it bears comparison with that of any of our neighbours, great or small. There is one item on the revenue account to which I should like to draw attention, and that is the item of £19,400, as against £19,900 last year, set on one side for our co-partners. It is called profit-sharing, but that is a very wrong name; it is not profit-sharing at all. That money, in due season, is invested in the Company's stock, and it becomes the property of the co-partners. To-day we have 1200 co-partners holding stock in the Company; and between them they hold £76,000. The system has been in operation for quite a long time; and that is the position to-day. The stock referred to Mr. Braine buys periodically on the market.

The Revenue Account.

Our profits on revenue account are rather more than those for 1925; and there are four very definite reasons for that: First, the increase in the price of gas; secondly, the increase in the quantity of gas sold; thirdly, the increase in receipts from residual products; and, fourthly, better working results from using a large proportion of American coal, some of which is, I regret to say, better in quality than the coal we are used to getting in normal times. There is a sum placed to the special purposes fund of £5757. It is the full amount which one half-year allows us to put; and I do not think many people have been in a position to do this; but we have, for the following reasons. We increased the price of gas for one quarter only—that was, from the September quarter—by 1·6d. per therm; and this brought in a considerable addition to our income. Then we also had the large increase to which I have already referred in the quantity of gas sold; and as we have not been doing anything special on which to spend money, this big increase in business has helped to carry on our other standing charges, and made them easier to bear. Then we had a very large increase in receipts from residual products. Coke and tar did very well. We have been told that we sold our coke much more cheaply than others did; and certainly you will find that our coke returns per ton are not so high for the year as those of some other companies. But this is in pursuance of the definite policy of the Directors. Rightly or wrongly, we said that we were going to supply coke as long as we could to people with whom we had contracts, and that we were not going to "put the screw on." We did all we could for the people we dealt with directly; and to some extent we have suffered from this. Towards the end of the strike, however, we did raise our prices for a short time. With regard to the fourth reason I gave you for the increased profit—namely, the better working results as compared with the previous year—I may say that we had the best results in the history of the Company per ton of coal used during the year. In fact, the yield has been second only to that of one of our big neighbours. The reason for this—though I do not like to say it—is that we had much better and much cleaner coal from America than you can get in this country. That is the truth, and you cannot get away from it. I only wish we could obtain coal of the same quality and the same cleanliness in this country.

The New "Ewell."

While dealing with the subject of coal, I may tell you that we have three boats now. The new "Ewell" has been something of an experiment on our part. She sailed up the Thames to London at the end of last July with over 2000 tons of coal in her. No ship had ever done the same journey before with such a cargo; but she accomplished it, and is now running very cheaply and very well in the service of the Company. Our old Chairman would have been delighted to see her. His celebrated "Wandle" took 1400 tons, and then we ventured up to 1700; but, as I say, now we have a ship that carries 2000 tons, and at not much greater cost. We can carry in the three ships we now have more than we previously could in our five ships; and we have only three captains and three crews. I should like to give you an instance of the sort of service we get from these captains and crews, who are north country men. On one occasion, one of the ships had not been to her home port for the long period of six months; and all this time we never heard a grumble. It was, as a matter of fact, only by chance that I got to hear of it at all. If that is not working for the Company, then I do not know what is. ["Hear, hear."]

Forthcoming Reduction in Price.

We have got at Wandsworth a new gasholder and some new purifiers. We have reconditioned some of our showrooms, and brought

them up to a state which we think more suitable for modern requirements. We have laid 14 miles of mains during the year, and the increase in gas appliances sent out has been enormous. It is interesting to note that over the whole of our area from the northern extremity, which is the Thames, to the southern extremity, which is Ashtead, wherever we have mains and there are houses, practically every house has got gas laid on, and it is being used. I have this on the authority of our Chief Engineer. I do not want to weary you with figures; but, as I have already told you, we put up the price of gas in September 1·6d. per therm. This would have meant in the ordinary course that your dividends would go down, because we were paying for 1925 the full amount to which you were entitled at the then selling price of gas; but fortunately for us, the Board of Trade issued what were termed the Gas (Amending Orders) Rules, by which it was laid down that if gas companies could prove they were hard hit they could apply to the Board of Trade to have added to their standard price what they estimated would be the extra cost of the strike. In our case, your Directors said: "1·6d. per therm from September, if the strike does not go on too long." The Board of Trade have granted this, and it enables us to recommend to you the payment of the full dividend which we should have been able to pay if there had been no strike, and the price of gas had remained as before. The new Order would run until June of this year. By the end of this month, we shall have had two quarters of the additional price of 1·6d. per therm; and the Board have agreed—and notices will go out to the consumers to this effect—that as from the March quarter meter readings, the price of gas will be reduced by 0·6d. per therm. I told you at the beginning of my speech that I was a bad prophet. I am not going to prophesy too much for the future; but if the other 1d. per therm does not come off at June, the cause will have to be something over which the Board have no control at all. Whenever you read about trade and finance, you find people tell you that you must get together, and work together more closely, and help one another. That may be right or wrong; but what I am going to say—not in any sense as an "S.O.S.;" we do not issue "S.O.S.'s" from Wandsworth—is that if any of our neighbouring companies have anything which they can offer us for our benefit, we shall accept it, after duly consulting the proprietors. No company has made suggestions to me, and I have made no suggestions to any other company; and I cannot imagine for one moment anyone coming along with an offer which would be very attractive to us. But if we can be of assistance to any neighbours, I want them to know that if they come along they will find the Directors and officials of the Wandsworth Company very reasonable people. We have great facilities at Wandsworth, and no doubt we could afford substantial help to our neighbours, if they liked to make use of it. We do not write to them; but if there is anything we can do, due to our geographical position, I make this as an offer.

The Deputy Chairman (Mr. R. Garraway Rice) formally seconded the resolution.

Mr. Warth remarked that the Company, under the care of the late Mr. Harry Jones, paid most excellent dividends; and he was glad to see that the mantle of the father had fallen upon the son. He thought the Directors were to be congratulated upon these accounts, in view of the very difficult times they must have gone through. They had his sincere thanks.

The motion for the adoption of the report and accounts was then put to the meeting, and carried unanimously.

Dividends and Re-Elections.

The Chairman proposed the payment of dividends for the half-year to Dec. 31 last at the rates per annum of 5 p.c. on the preference stock, 8½ p.c. on the Wandsworth "A" stock, 7 p.c. on the Wandsworth "B" stock, £5 19s. p.c. on the Wandsworth "C" stock, £6 12s. 6d. p.c. on the Wimbledon stock, £7 2s. 6d. on the Epsom stock, and £5 19s. p.c. on the new ordinary stock.

Dr. T. A. Ives Howell seconded this, and it was agreed to.

The Chairman said he had much pleasure in proposing the re-election as Directors of the Company of Dr. T. A. Ives Howell and Mr. G. F. Page. Both gentlemen, he said, had been on the Board for a very long time, and each was a necessary part of the undertaking. They were not only two very charming colleagues, but they were of great help to him personally.

Mr. R. M. Chart seconded the proposal, which was passed unanimously.

Dr. Howell, returning thanks, said it was now 32 years since he joined the Wandsworth Board.

Mr. Page remarked that his service was only a year or two short of that of Dr. Howell.

Moved by Mr. J. C. Potter, the retiring Auditor (Mr. H. Willis Smith) was re-appointed.

The Chairman said that, as he probably knew them better than anyone else in the room, he would like to propose that the hearty thanks of the meeting be given to the Secretary, the Engineer, and the whole of the staff and workmen of the Company, for their services during the past year. For the Directors, though it had been rather an anxious one, it had not been a very strenuous year; but everybody in the service of the Company, from the top to the bottom, had shown unbounded enthusiasm and had done an extraordinary amount of hard work. He wished to thank them for having made the task of the Directors so comparatively easy.

Mr. B. R. Green seconded the proposition with pleasure, for he recalled a time when he himself received such a vote as this with keen appreciation.

Mr. Hennell said that, both as a shareholder and as a consumer, he would like to support the vote. He came across a good many of the staff and employees from time to time, and had been struck by their obvious loyalty to the interests of the Company and of the consumers. It was a joy to meet them and find them so keen on their work, and so anxious to make the undertaking a continued success. He hoped the Chairman would go on emphasizing at meeting after meeting the great necessity for profit-sharing throughout industry. It enabled men to realize that they had a stake in the success of the concern in which they were employed.

The Chairman said that Mr. Hennell was the Auditor of the Company's pension fund, and came in contact with the men. It was very pleasing to hear him praise them so highly.

The vote having been passed by acclamation,

The Secretary said he had responded, on behalf of himself and his staff, to such a vote for about thirty years past. The work done by the Company's staff was as good now as it had ever been.

Mr. C. M. Croft (the Chief Engineer), speaking for the officers and employees on the works, said that everyone did his level best to forward the interests of the Company.

The Chairman remarked that he noticed among those present Mr. Johnson, who had been for a long time on the Works Committee, and he would like him to return thanks also.

Mr. Johnson said he had worked for the Company for some twenty years; and he was pleased to be able to tell them that, though he had worked for other good concerns, this was the best Company in whose service he had ever been. The men in general recognized that they enjoyed a great privilege in being able to work for a company who treated them in the manner that the Wandsworth Company did. It was unanimously agreed on the works that if other companies were to treat their men in the same manner as did the Wandsworth Company, labour troubles and unrest would cease to-morrow. ["Hear, hear."]

A cordial vote of thanks was passed to the Chairman and Directors, on the proposition of Mr. Warth, seconded by Mr. Potter.

BRIGHTON AND HOVE GENERAL GAS COMPANY.

Business Developing Satisfactorily.

The Ordinary General Meeting of the Company was held at 5, Great Winchester Street, Old Broad Street, E.C., last Friday—Mr. A. M. Paddon, M.Inst.C.E. (the Chairman), presiding.

The Secretary (Mr. H. C. Burton, A.C.A.) read the notice convening the meeting; and the report of the Directors and statement of accounts for the year ended Dec 31 were taken as read.

The Chairman, in moving the adoption of the report and accounts, said they bore, as all such statements must, a record of the loss and disability incurred by reason of the great industrial disturbance. This sort of preface was necessary in the case of any gas company rendering an account of their stewardship at the present time. But although these consequences were clearly indicated in the figures of their accounts, there were nevertheless some very encouraging features to be noted. In the first place, there had been an increase in the sales of gas, as compared with the preceding year, of something like 2½ p.ct., representing about 51 million c.ft. Some of the proprietors might have anticipated a larger increase, by reason of the enhanced duty that gas had to perform to the community during the disturbed period. It would be remembered, however, that certain limitations were imposed upon the use of gas with regard to street lighting; and there was a very wholesome spirit of economy engendered by the warnings of the Government, and a general appreciation of the great difficulties which had to be encountered if the supply of gas was to be maintained. Since the beginning of the present year the development of the business had been at double the rate recorded in the report. The Company had suffered a loss through the death of Mr. P. W. Colley, who had been successively an Auditor and a Director for upwards of 48 years, and had done most valuable work. Mr. E. L. Burton, having relinquished the office of Secretary—a position which he had held for over 31 years—was appointed a Director to fill the vacancy. He did not know that there had been a very great change in the personal relations between the Board and Mr. Burton. The Directors had always regarded him as being something more than an executive officer; and doubtless the proprietors would agree that the choice of him to fill the vacancy on the Board was a wise one. Mr. H. C. Burton had succeeded his father as Secretary, and amply satisfied all the requirements of the Directors in this respect.

The Year's Results.

The total capital expenditure of the Company amounted to £927,000 odd, which was under £450 per million c.ft. of gas sold. In the revenue account, on coal, oil, and coke they had expended £308,000; and even when this had been reduced by an appropriate transfer of £15,000 from the special purposes fund, it still amounted to £293,745, or over £46,000 more than the year before. They had had, of course, to take extraordinary measures to meet abnormal conditions. Undertakings which were dependent upon sea-borne coal had to take what was offered in the quantities that were available. Towards the end of the disturbed period the main source of relief was America, from which part of the world there was sent over a very high-class gas coal; but the consignments were large in quantity. Not much came over in smaller than 6000 ton vessels; and sometimes 11,000 and 12,000 tons was reached. The last consignment they had had to buy was 7000 tons; and at 80s. per ton, this was an important matter to them. As he had pointed out, a sum of £15,000 had been transferred from the special purposes fund—a fund really formed to meet just such an emergency as this—and the carry-forward had been reduced by a little under £8000. Repair and maintenance charges were ample, at over 18d. per 1000 c.ft. The expenditure on

revenue account, at £584,717, exceeded that of twelve months ago by £54,665. The receipts, on the other side of the account—owing mainly to the increase in the price of gas, the growth in the business, and the economies naturally exercised—were more by £47,548. The difference between the increase in expenditure and the increase in receipts was thus £7116, which went in reduction of profit. There was brought into the profit and loss account £44,141, and they would be carrying forward to the next account £36,316. It had been necessary to increase the price of gas only from 9·5d. to 10·4d. per therm. This represented a very limited demand upon the public in the solution of the problems to which the past year's events had given rise; but nevertheless the Directors were not without hope that they might in the near future be able to improve their relations with the public in this respect. As their annual make of gas was now over 2100 million c.ft., the undertaking had become an extremely important one. The allocations to benefit fund account, co-partnership, and employees' sick benefit and hospital fund represented the cost of good relations between employers and employed; and this relationship was everything that could be desired. Not only were their people loyal to the Company during the industrial upheaval, but they were both enthusiastic and energetic in doing all they could to promote the public service and maintain the good name of the Company. ["Hear, hear."] This was all due to co-partnership, the value of which to the undertaking he could not adequately convey to the proprietors.

The DEPUTY CHAIRMAN (Mr. G. W. Carey) seconded the motion, which was warmly supported by Mr. A. W. OKE and Mr W. A. HOUNSOM, and carried unanimously.

Dividends were declared making 12 p.ct. for the year on the original ordinary consolidated stock and 9 p.ct. on the "A" ordinary consolidated stock, both less income-tax.

The retiring Directors (Messrs. F. H. Jones and J. M. Miles) were re-elected, as was the retiring Auditor (Mr. Lewis Hardy, F.C.A.). Mr. William Cash, F.C.A., was appointed Special Auditor to audit the accounts for 1926 in conjunction with the Auditor appointed by the Brighton Corporation.

The proceedings were brought to a close by votes of thanks to the officers and staff (on the proposition of the CHAIRMAN), and to the Chairman and Directors (moved by Mr. J. TAYLOR).

NORTH MIDDLESEX GAS COMPANY.

Satisfactory Increase in Business.

The Ordinary General Meeting of the Company was held on Monday, Feb. 28, at 5, Great Winchester Street, E.C.—Mr. A. M. PADDON, M.Inst.C.E. (the Chairman), presiding.

The SECRETARY (Mr. Hyde C. Burton, A.C.A.) read the notice convening the meeting; and the report and accounts for the year ended Dec. 31 were taken as read.

The CHAIRMAN, in moving the adoption of the report and accounts, said he felt sure that a perusal of them must have removed from the minds of the proprietors any apprehensions they might have felt as to adverse circumstances re-acting upon them, in view of the industrial disturbances last year. The report stated that the sale of gas for the year showed an increase of 250,493 therms, or 8·8 p.ct., as compared with that for the preceding year; but perhaps it would be more intelligible to those present if he said at once that the increase amounted to 50 million c.ft. This, of course, was a very material and gratifying gain. In order to maintain the supply of gas during the cessation of work in the mining industry, the Directors were compelled to purchase large quantities of foreign coal, involving heavy additional expenditure. To meet this increased cost, the price of gas was raised as from Michaelmas last from 10·5d. to 11·2d. per therm, and as from Christmas last from 11·2d. to 12d. per therm. He was, however, glad to say they were announcing a reduction in price of 1d. per therm, which would bring them back to the far more practicable figure of 11d.; and from time to time as they could revert to their former low standard of charge, they would do so. The conversion of the ordinary capital authorized by the Company's Special Order had been completed. The report also told them that the Directors had elected Mr. E. L. Burton to a seat on the Board, on his relinquishing the office of Secretary, which he had held for the past 28 years, and had appointed Mr. H. C. Burton to succeed him. They were glad to have with them on the Board a colleague of such wide experience. The Company still had powers to issue nearly £200,000 of ordinary stock, and something like £100,000 of debenture stock. They were therefore well covered in this respect. The amount of capital employed—namely, that issued *plus* the loan from the bank—was about £555 per million c.ft. of gas, which was not at all an unreasonable figure. It was a low amount, though they hoped to see it lower. They had recently issued at a premium £30,000 of preference stock. In the revenue account, the first item showed what they had had to pay in order to meet the great strike contingency. Altogether this item exceeded that of a year ago by nearly £20,000. The total expenditure was larger as compared with a year ago by £22,595; and to meet this, their receipts showed on the other side an addition of £22,114. Thus there was only a small balance of £481 to account for; and the profit was diminished precisely to this extent. The charges for the co-partnership fund (£1825), Sick and Benefit Club (£354), and pensions (£202) were all important. If at such comparatively trifling cost as was shown here they could produce, maintain, and develop conditions between themselves and their employees which gave absolute satisfaction, and exorcised that evil spirit of ill-feeling which was seen elsewhere, they would agree with him that it was money well spent.

PROFIT AND LOSS ACCOUNT.

Turning to the profit and loss account, they brought in some £4227 of undivided profits, and were taking forward £930. The difference of £3297 represented the ultimate effect of the coal stoppage. Considering the disastrous period through which they had passed, they had not done badly. The disorganization caused by the strike extended over a great part of the year, and placed a very great strain upon those responsible for the conduct of the undertaking.

Mr. H. A. LERMITTE seconded the motion; and it was carried unanimously.

Dividends were, on the proposition of the CHAIRMAN, seconded by Mr. H. F. LOFTS, declared, making a distribution for the year of 11¼ p.ct. on the original ordinary stock, £8 1s. p.ct. on the additional ordinary stock, and 5 p.ct. on the preference stock—all less income-tax.

Messrs. F. H. Jones and H. F. Lofts were re-elected Directors; and the Auditor (Mr. Lewis Hardy, F.C.A.) was re-appointed.

The CHAIRMAN proposed, and Mr. F. H. Jones seconded, a hearty vote of thanks to the Secretary, the Engineer and Manager (Mr. Lawrie Trewby), their staffs, and the co-partners generally. The Chairman said everyone had displayed the utmost zeal and loyalty, and the work had been extremely well done.

Mr. LAWRIE TREWBY, in response, remarked that it was perfectly true that his staff had done very well indeed. All were looking forward to 1927 being a good year.

Mr. H. C. BURTON also acknowledged the vote.

Mr. J. R. GALE, speaking on behalf of the Co-partners, said they had a thriving social club, the membership of which now stood at over 200. One very pleasing feature of the accounts was the big increase in the average consumption per meter over the Company's district. In the year 1913, when the price was 3s. 4d. per 1000 c.ft., the average consumption per meter was 27,000 c.ft.; whereas in 1926 it had risen to 37,000 c.ft. During the last quarter they had had a record number of 360 new consumers.

Proposed by Mr. F. G. PILLEY, seconded by Mr. W. B. FARQUHAR, the Chairman and Directors were heartily thanked for their services.

BARNET DISTRICT GAS AND WATER COMPANY.

Ten P.Ct. Increase in Gas Sales.

The Ordinary Half-Yearly General Meeting of the Company was held on Monday, Feb. 28, at the Cannon Street Hotel, E.C.—Mr. WILLIAM RICHARDS in the chair.

The SECRETARY (Mr. E. D. Davey, A.C.A.) read the notice convening the meeting; and the report of the Directors for the six months ended Dec. 31 and the statement of accounts were taken as read.

Mr. RICHARDS, in moving their adoption, said that, in the first place, he was sorry to tell them that the Chairman, Mr. William Cash, was unwell, and could not be present. Neither could Dr. Glaisher, the Deputy-Chairman, be with them for the same reason. Both had written expressing great regret at their absence—a regret which would be shared by all. As to the stock and share capital account, there had been no further issue since the last meeting. It would be seen that £175,000 of ordinary stock remained to be issued, £140,000 of this being the new capital authorized by their Act of last year. No further loan capital had been raised within the half-year; but they had issued £17,500 of debenture stock which ranked for interest as from Jan. 1 last. The total borrowing powers were now increased from £124,850 to £349,000. It was proposed to take steps in the immediate future to issue more debenture stock; and a resolution in connection with this would be submitted later. The sales of gas showed an increase of 10 p.ct. during the half-year—and this in spite of a request which was made to the consumers to economize as far as possible in the use of gas. Of course, the half-year had had to bear the full brunt of the coal strike costs. The price of gas was raised from 10½d. to 12½d. per therm from Sept. 30; but this increase did not nearly cover the heavy additional cost of imported coal. Therefore the price of 12½d. was in force to-day; but he was glad to be able to announce that, as from the reading of the meters for the March quarter, it would be possible to make some reduction. Fortunately, at the time the strike occurred they had a large stock of coal on hand. They connected-up 265 new consumers during the first half, and 267 during the second half of the year—a total of 532, which was clear evidence of the vitality of the business. On the other side of the account, the items that attracted most attention were coal, oil, and coke for carburetted water gas. These totalled £32,956, as compared with £19,935 for the corresponding half of the previous year; and there they saw the reason for the increase in the price of gas. Under the provisions of their Act of last year, the Directors were now allocating the management expenses somewhat differently. Hitherto they had been divided equally between the two branches of the undertaking; but now that the water side had become so much larger than the gas, it had been

thought advisable to make the division proportionate to the capital expended. The water revenue account was extremely satisfactory. It was up by about £2400; but the balance carried to the profit and loss account was slightly less, owing to the increased expenditure on fuel for pumping. In the profit and loss account, the profit from gas was on the present occasion only £1565, as compared with £4385 for the corresponding half of 1925; but he had already explained the reason for this serious diminution. The balance of net profit was £41,757; and after deducting the amount required for dividend, there remained to be carried forward £23,457 to the credit of the next half-year. This, taking also into account the contingency and reserve funds, showed them to be in a very satisfactory position.

THE PARLIAMENTARY BILL.

With regard to the Company's Bill in Parliament, the Chairman at the half-yearly meeting in September explained the then position, which was that the House of Lords Committee had sanctioned the Bill, with the well at Stanborough which the Company were desirous of sinking. They had hoped that when the measure reached the House of Commons they might be equally successful; but in this they were disappointed. They had had very strenuous opposition to meet—particularly from the Hertfordshire County Council. The result, he feared, would be that the Company would ultimately be forced to take water from the Metropolitan Water Board, on what the Directors regarded as very onerous terms. Under their previous Acts, the Board had not power to supply them; but they were promoting a Bill in the present session of Parliament to give them authority to supply outside their district. One advantage of an arrangement with the Board, of course, would be that the Company would get a certain supply without any element of speculation such as inevitably attached to sinking wells; and behind this supply there was the enormous storage capacity possessed by the Metropolitan Water Board. Against this, however, one must put the question of price, which, as he had already said, the Directors considered very high. This would mean a burden on the consumers. It had been a most costly fight for everybody concerned. They were in Committee in the House of Lords for ten days, and in the House of Commons for twelve days. The Directors gave the proceedings their closest attention; and they were particularly well served by their Counsel and their Parliamentary Agents (Messrs. Rees & Freres). Having listened to all the evidence, he could say, too, that their witnesses did the very best they could for the Company. The staff worked particularly hard; and upon the shoulders of their Engineer and Manager (Mr. J. F. Haseldine) rested a heavy task and responsibility. In the opinion of the Board, Mr. Haseldine acquitted himself extremely well. Although they had lost their well, the Company did, as a matter of fact, obtain by the Act some very valuable further powers—including power to purchase additional water and gas lands, to acquire the Hatfield Water-Works, to extend their water area, and to convert and consolidate their capital. Another thing was that in future they would be able to dispense with the half-yearly meeting in August. They would pay an interim dividend at the usual date. The new Act also gave them power to establish profit-sharing, when it appeared to them advantageous to do so.

Mr. COLIN DOCWRA seconded the motion, which was carried unanimously.

On the proposition of the CHAIRMAN, seconded by Mr. ALFRED WOOD, dividends were declared, less income-tax, for the half-year to Dec. 31, at the rates of 10 p.ct. per annum on the "A," "B," and "C" stocks and 7 p.ct. per annum on the "D" capital gas and water stocks.

The retiring Directors (Messrs. William Cash and Alfred Wood) and the retiring Auditor (Mr. C. P. Crookenden) were re-elected.

The CHAIRMAN said they next had to consider the question of special remuneration of the Chairman of the Company. When they were promoting the Bill to which he had just been making reference, it was naturally wished that Mr. Cash should give the Company the utmost benefit of his wide experience in these matters; and he thought the shareholders would agree that the important work Mr. Cash did in connection with the Bill should be recognized in the usual way. He therefore proposed that Mr. Cash be paid a fee of 600 guineas for his personal services in connection with the Bill.

Mr. J. TAYLOR seconded this, and it was unanimously agreed to.

An Extraordinary General Meeting was then held, at which, on the motion of the CHAIRMAN, seconded by Mr. DOCWRA, the Directors were authorized to issue £147,900 of 5 p.ct. perpetual debenture stock.

Proposed by the CHAIRMAN, and seconded by Mrs. SEXTON, a hearty vote of thanks was accorded the officers, staff, and workmen for their loyal services during a particularly strenuous and anxious year; and a similar compliment to the Chairman and Directors, on the motion of Mr. TAYLOR, seconded by Mrs. SEXTON, brought the proceedings to a close.

Rochester, &c., Gas Company's Stock Issue.—The £20,000 of consolidated ordinary stock in the Rochester, Chatham, and Gillingham Gas Company, which was offered by Messrs. A. & W. Richards on behalf of the Directors, was over-subscribed. The tenders ranged from £100 2s. 6d. down to the minimum of £92 10s. per £100.

New Gas Retorts for Southport.—At the Southport Council meeting on March 1 the Gas Committee resolved that the tender of West's Gas Improvement Company, Ltd., of Albion Iron Works, Miles Platting, Manchester, of £33,622 for an installation of Glover-West vertical retorts and waste-heat boilers, be accepted, and that the tender of the Standard Furnace and Setting Company, of Southport, of £5000 for repairs to horizontal retorts be accepted. Councillor J. H. Hindle, Chairman of the Gas Committee, in moving the minutes, said that the consumption had greatly increased since the last retorts were installed in 1912. There would be no loan for the expenditure on repairs to the horizontal retorts, which would be paid for out of revenue. The proposals were approved.

GAS COMPANIES' RESULTS FOR 1926.

Andover.

Notwithstanding the difficulties caused by the coal strike, there was an increase in gas sales of 5 p.ct. The price of gas had been raised by 1½d. per therm from Sept. 29, and by 1d. per therm in mid-November. The Directors now announce a reduction of 1½d. per therm as from the readings of the meters for the March quarter. It is hoped that a further reduction of 1d. will be made in June. Increased business resulted from the acquisition of new showrooms. The Chairman, Mr. W. P. Clarke, at the annual meeting, proposed the following dividends: For the half-year ended Dec. 31, 1926, 5 p.ct. per annum on the ordinary, and 6 p.ct. on the preference stock; and similar dividends for the half-year ending June 30, 1927 (in both cases less income-tax).

Barnstaple.

The report submitted at the annual meeting of the Barnstaple Gas Company showed that the balance standing to the credit of the profit and loss account amounted to £6437, out of which the Directors recommended the payment of a dividend, less income-tax, for the year ended Dec. 31, at the rate of £10 10s. p.ct. per annum on the "A" shares and £7 7s. p.ct. on the "B" shares. The charge for gas was increased during the December quarter on account of high prices paid for foreign coal; but in view of the improved coal position, the Directors had reduced the charge for the current quarter to the rate obtaining before the stoppage—namely, 11·2d. per therm (4s. 8d. per 1000 c.ft.). The Chairman (Mr. F. W. Hunt) pointed out that, notwithstanding the strike, the Company had enjoyed a year of success; and though the coal carbonized cost £3115 more than in 1925, it was possible to supply gas at the price ruling before the strike except for one quarter only, and the dividend recommended was only slightly less than that of last year.

Blyth.

Reviewing the accounts at the annual meeting of the Blyth Gas Company, Mr. Alex. Watt, the Chairman, said that residual products showed an increase of £1544. The total number of consumers served by the Company was 10,175. Alluding to the advancing competition of electricity, Mr. Watt said that the question of introducing maintenance schemes was under the consideration of the gas industry; and the Directors were alive to the necessity for such a scheme being introduced locally. The report, which recommended a dividend of £3 17s. 6d. p.ct., less tax (making £7 15s. for the year, less tax), was adopted.

Bognor.

Moving the adoption of the report and accounts at the Half-Yearly Meeting of the Bognor Gas Light and Coke Company, Alderman J. G. Denton, J.P., said that the balance-sheet showed a balance of £15,762 at the credit of profit and loss account. The protracted coal strike caused the Directors and management anxiety. The supply of gas, however, was fully maintained during the whole period, though the greatly increased cost of foreign coal compelled the Board to advance the price of gas by 1·26d. per therm for the December quarter. The Directors withdrew the increase as from Jan. 1. Substantial increases in the output of both gas and electricity had been recorded for the past half-year; there being over 15 p.ct. on gas and 20 p.ct. on electricity compared with the corresponding period of 1925. The following dividends were approved: At the rate of £6 15s. p.ct. per annum on the original "A" stock; £7 9s. on the original "B" stock; £6 15s. on the additional "A" stock; and £6 15s. on the new consolidated stock. These dividends will amount to £2694, leaving a balance of £13,067 to the credit of profit and loss account.

Cheltenham.

Mr. C. L. Grundy (Chairman) presided at the annual meeting of shareholders of the Cheltenham Gas Light and Coke Company. In moving the adoption of the Directors' report, he said the Company, like others, had had a very anxious year owing to the coal stoppage, but, thanks to the general policy of carrying a good stock of coal and to the foresight of the Engineer in buying foreign coal well in advance of requirements, the Company had been able to maintain a full supply of gas throughout the year. The accounts showed they had had a successful year, in spite of the difficulties under which the gas industry had laboured. The amount paid for coal was nearly £29,000 in excess of the previous year's figure; while, on the other side, the sale of gas was up by £11,852 and of coke by £13,621. The sale of gas for the year constituted a record, being 541 million c.ft., which was an increase of nearly 37 millions on the previous year's output. The report and accounts were approved. A dividend was declared at the rate of 5 p.ct. per annum on the paid-up consolidated ordinary stock for the year.

Chichester.

In their report for the half-year ended Dec. 31 last, the Directors stated that the balance standing to the credit of profit and loss account amounted to £6524. They recommended the declaration of dividends for the half-year at the rate of 10 p.ct. per annum on the "A" capital stock, and 7 p.ct. per annum on the "B" and "C" stocks, absorbing £1567. Presiding at the half-yearly meeting, Mr. W. W. Walker (Chairman) said that the working results had been very satisfactory. They had sold during the half-year 35,475,000 c.ft., compared with 32,036,000 c.ft. for the corresponding period in 1925, and the number of consumers had increased by 164.

Derby.

An interim dividend on the ordinary stock of 3 p.ct. was paid; and at the annual meeting a final dividend was declared of 4½ p.ct., making 7½ p.ct. (less tax) for the year. The Company's business showed a marked increase over 1925. There was an increase of 1930 in the number of consumers, and the sale of gas increased by 48 million c.ft. Gas cooking stoves and fires sold or on hire increased by

4189, and there was an increase of 2200 in other gas appliances for domestic and industrial purposes. A full supply of gas was maintained during the whole of the coal stoppage, without any increase in the price. The extra expenditure on coal and oil caused by the strike amounted to £51,937 after allowing for the increased quantity of gas made. Mr. W. Wooley (Chairman) said that the capital account was over-expended by £66,397; but as they had ample reserves, it was not thought desirable to issue new capital at present. In the near future, however, the Directors would invite stockholders and others to provide additional capital.

East Grinstead.

After the payment of the interim dividend, interest on debentures, and other fixed charges, the profit and loss account showed a balance of £9297 available for dividends. The Directors recommended the payment for the half-year ended Dec. 31 last of 5 p.ct. on the original "A" stock and "A" shares, and 3½ p.ct. on the "B" and "C" shares (less income-tax), which, with the interim dividends, made 10 p.ct. and 7 p.ct. respectively for the year. This absorbed £2511, leaving £6786 to be carried forward. Mr. W. H. Hills (Chairman of Directors) stated at the annual meeting that during the year they had installed a carburetted water gas plant of a capacity of 250,000 c.ft. per day, practically doubling the existing facilities for manufacture. Despite the extension of electricity, their sales of gas continued to expand; and the increase in 1926 amounted to over 10 million c.ft. The Chairman said that Mr. J. B. Allwork, one of the Directors, had resigned from the Board owing to failing health. Mr. D. T. Livesey, their Engineer, Manager, and Secretary, had been with them for 33 years, and there was a probability of his seeking retirement from active work in the near future. In that event, he thought Mr. Livesey should be offered a seat on the Board. There was agreement with this proposal.

Elland.

At the annual meeting of the Elland-cum-Greetland Gas Company, it was reported that the sales of gas for the year were the highest in the history of the Company. Despite increased expenditure owing to the cost of Continental coal to supplement considerable supplies which eventually became exhausted during the coal strike, the Company have decided to reduce the price of gas by 4½d. per 1000 c.ft. after the end of the current quarter. A dividend of 6¾ p.ct. was declared.

Faversham.

The revenue account showed receipts £27,184, and expenditure £21,860, leaving a balance of £5324 to carry to profit and loss account. The dividends paid to the preference stockholders on July 1, 1926, and Jan. 1, 1927, amounted together to £272, and the interim dividend on the original stock and the new ordinary stock for the six months to June 30 last amounted to £1186. This left £2917, which, with the sum brought forward from last account, made a balance of £4534. Out of this the Directors recommended that dividends for the six months ended Dec. 31 be declared at the rate of 8 p.ct. on the original stock and £6 4s. p.ct. on the new ordinary stock, less income-tax. This would absorb £2442, leaving a balance of £2092 to be carried to the next account. Mr. Charles Cremer (Chairman of Directors), who presided at the annual meeting, stated that the increase in the sales of gas amounted to about 13 p.ct. The showroom was doing exceedingly well. When it was opened in 1919 the amount of business done in the year was £357. Last year the amount was £2528. The price of gas would be reduced on April 1 by 1d. per therm.

Launceston.

The report of the Directors of the Launceston Gas Company stated that, though the Company had to pay a greatly enhanced price for coal during the strike, the price of gas was increased by only 1·2d. per therm, equivalent to 6d. per 1000 c.ft. To meet the growing demand for gas, a new setting of retorts had been erected. The revenue account showed a profit of £736, while the balance at profit and loss account was £736. The capital of the Company had been increased during the year by the issue of 205 ordinary shares. The Directors recommended the payment of a dividend of 8s. per share on the ordinary shares, and 7s. per share (from the date of issue) on the additional shares, less income-tax. The Company intend to open new showrooms in Broad Street, Launceston.

Newmarket.

The balance brought forward was £10,739, less debenture interest for the year (£162), leaving £10,576. The profit earned during the year ended Dec. 31 last was £2929, making the balance at credit of profit and loss account £13,505. The Directors recommended a dividend on the original consolidated stock at the rate of 8 p.ct. (less tax), leaving £9665 to be carried forward. The sale of gas considerably increased during the year. Mr. R. Stephenson, the Chairman, who presided at the annual meeting, stated that they had sold 10 p.ct. more gas to domestic consumers, in spite of their efforts to urge economy in gas consumption. The Company were proud of being able to get through the strike without having to increase the price of gas.

Northwich.

The annual meeting of the Northwich Gas Company was held on Feb. 28, Mr. C. T. Eachus (Chairman) presiding. The Chairman, before commencing the business of the meeting, referred to the loss the Company had sustained through the death of Mr. W. J. Yarwood (the late Deputy-Chairman), who had been a Director nearly seventeen years. In moving the adoption of the report and balance-sheet, he gave a lucid statement of the year's working, pointing out that, had it not been for the coal strike, the Company would have had a record year. He mentioned the arrangements respecting the supply of gas to Messrs. Brunner, Mond, & Co.'s works at Winnington and Wallerscote, and gave particulars of the increasing business in other districts within the area of supply. Mr. J. D. Hesketh seconded the resolution, and supported the Chairman's remarks. He mentioned that, though the strike commenced on May 1, the price of gas was not raised until the end of September. The price would be reduced at the earliest opportunity. Dividends were declared at the rate of 4 p.ct. per annum on the preference shares (free of income-tax), and 7 p.ct. per annum on the ordinary stock (less income-tax) for the past half-year, making, with the interim dividend, 4 p.ct. and 6 p.ct. for the whole year respectively. In order to do this, the sum of £1531 was transferred from the reserve fund. Immediately after the general meeting was concluded, an extraordinary general meeting was held, when the Chairman stated that new capital would be required to carry on the business of the Company. Resolutions were unanimously passed for new capital to be raised.

Reading.

At the annual meeting, it was explained that the income for the year was £263,670 and the expenditure £249,089, leaving a balance of £14,581. The sum available for distribution was £35,314. The Directors recommended the payment of dividends at the statutory rates for the half-year ended Dec. 31 last; interim dividends at this rate having been paid. Mr. T. E. Hewett, the Deputy-Chairman, presided at the meeting; and he mentioned that throughout the whole of the strike the Company maintained an uninterrupted supply of gas. Foreign coal was very costly; and they were compelled to increase the price of gas by 0·8d. per therm from Michaelmas, making the price to ordinary consumers 9·2d. per therm. Their increase in sales amounted to 38 million c.ft., notwithstanding the restrictions on public and shop lighting during the period of the strike. Last year they placed a contract with West's Gas Improvement Company, Ltd., for another installation of vertical retorts, which when completed would produce 3 million c.ft. of gas per day. In the district, 767 new consumers were afforded a supply of gas, and 1602 additional cookers and fires were installed on hire. A special meeting was afterwards held for the purpose of considering a Bill to empower the Company to acquire land for the provision of additional storage.

Southgate.

Sales of gas by the Southgate and District Gas Company for the year 1926 show an increase of 132,876 therms, or 7·86 p.ct., over the previous twelve months. The price of gas was raised as from Michaelmas last from 11d. to 11·8d. per therm, and as from Christmas to 13d. per therm; while a sum of £3000 has been transferred to a suspense account to be liquidated out of the increased charge for gas during the current year. Dividends, less income-tax, are being paid of 10 p.ct. on the original capital and 7 p.ct. on the additional capital—leaving £3472 to the credit of the profit and loss account to be carried forward.

Sunderland.

Speaking at the annual meeting of the Sunderland Gas Company, the Chairman (Alderman W. F. Vint) said their coal bill last year was about four times what their coal cost them on their ordinary contracts. Owing to increased costs, the price of gas was raised to 4s. per 1000 c.ft., but for the first quarter of the present year had been reduced to 3s. 6d. He had confidence in anticipating that in the next quarter there would be a further reduction. The Company now supplied twelve times as much gas as they did seventy years ago, and more than twice as much as they supplied thirty years ago. A final dividend was declared of 3 p.ct. on the ordinary stock for the six months ended Dec. 31, less income-tax.

Whitby.

At the recent annual meeting of the Whitby Gas Company, when a dividend of 2½ p.ct. was declared on the original capital, and 1¾ p.ct. on the additional and new capital, for the half-year ended Dec. 31 last, it was reported that over 200 new consumers had been connected during the year. The dividend will absorb £765 out of the available balance of £2117, leaving £1352 to carry forward. The sales of gas show an increase of 14·6 p.ct. over the previous year.

Wolverhampton.

At the annual meeting of the Wolverhampton Gas Company, Mr. A. B. Hanbury-Sparrow, J.P., Chairman, said that after paying interest on the debenture stock, and appropriation to the special purposes fund, the net profit for the year was £16,527, as compared with £28,461 in the previous year. The Directors recommended dividends at the same rate as for the previous half-year—viz., 3 p.ct. on the preference stock, 5½ p.ct. on the consolidated stock, and 3½ p.ct. on the new ordinary stock, though to enable them to do this they had to take the sum of £1647 from the balance carried forward in 1925. He was glad to state that the sales of gas showed an increase of 73 million c.ft., equivalent to nearly 7 p.ct. In view of the increasing demand for gas, a third installation of vertical retorts was being erected at the works. It had been possible to reduce the price of gas by 9d. per 1000 c.ft. as from the end of the March quarter; and it was hoped that shortly they would be able to revert to normal prices.

Worthing.

Presiding at the annual meeting of the Worthing Gas Light and Coke Company, the Deputy Chairman (Alderman J. G. Denton, J.P.) stated that the Directors had during the year issued £27,195 of 5½ p.ct. irredeemable preference stock at an average price of £93 7s. 3d. p.ct. The profit and loss account showed a balance of £23,631. Out of this the Directors had paid interim dividends (less income-tax) of £2 15s. p.ct. on the preference stock and £3 5s. p.ct. on the consolidated ordinary stock; and they recommended the declaration of final dividends at the same rates. The sales of gas had increased by no less than 14 p.ct., following an increase of 10 p.ct. in 1925. The Directors had decided to reduce the price of gas to 1s. per therm at the end of the current quarter.

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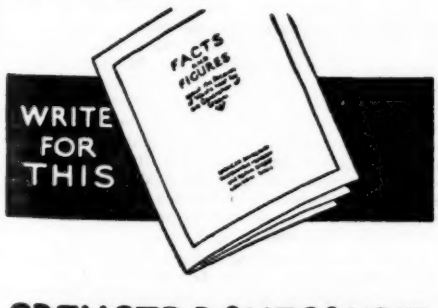

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COAL TRADE REPORTS.

From Our Own Correspondents.

NORTH-EAST COAST.

Idle days at many collieries are once again quite an ordinary occurrence, and show the unfortunate condition of markets. The big demand which was anticipated at the end of the stoppage has, in reality, never materialized, at any rate as far as this district is concerned. It is, of course, essentially dependent upon export trade, and the Continent can apparently satisfy its requirements advantageously elsewhere. Quotations for Durham and Northumberland are, in most cases, now as low as costs will permit, but little more is being done than hand-to-mouth orders, which are often taken at a cut price by a colliery temporarily in greater need than its neighbours. The ascertainments based on January working which govern March wages show that once again the minimum rate clause comes into effect, as the actual percentage given by the results falls below it. The pits have, since then, probably got more into their stride, and increased output will mean reduced costs. But against this there has been a steady fall in prices.

The better quality gas coals have been steadier lately on better demand for home account. Wear Specials maintain a quotation of 18s. f.o.b., and best qualities ask 17s. 9d. to 18s. Seconds are called 15s. 6d. to 16s., but are plentifully available at the lower figure. Coke continues in good demand, gas makes asking 23s. to 23s. 6d. f.o.b., but coking coals are weak, good qualities having been sold down to 15s. 6d. In all sections of the market the volume of trade is exceedingly disappointing, and offers no security for the regular working of the pits, which is so essential to the keeping down of costs.

YORKSHIRE AND LANCASHIRE.

Gas coals in the open market in Yorkshire and Lancashire are discounted from previous contracts.

The export market is moving steadily, and will no doubt appreciate in the future.

Household coals of the better descriptions are discounted in value this week, with secondary qualities moving freely.

Industries are not recovering quite so quickly as the lay Press would lead people to believe. Prices for this description of coal vary with the position at each supplying colliery.

The following are the Humber bunker and export prices, f.o.b. usual shipping ports: South Yorkshire—Hards, Association, 22s. 3d. to 22s. 6d.; screened gas, 22s. to 22s. 6d.; washed trebles, 25s. to 26s.; washed doubles, 21s. 6d. to 22s.; washed singles, 19s. 6d.; washed smalls, 16s. 6d.; unwashed doubles, 17s. to 18s.; rough slack, 12s. 6d. to 12s. 9d.; smithy peas, 23s. to 25s. 6d. per ton. West Yorkshire—Hartleys (f.o.b. Goole), 21s to 22s. 6d.; washed trebles, 25s. to 26s.; washed doubles, 20s. 9d. to 22s.; washed singles, 18s. 6d. to 19s. 6d.; washed smalls, 14s. 3d. to 15s.; unwashed doubles, 17s. to 18s.; rough slack, 13s. 6d.; coking smalls, 11s. 6d. to 12s. per ton. Derbyshire and Nottinghamshire—Top hards, 23s. to 25s.; washed trebles, 23s. 6d.; washed smalls, 14s. 6d. to 15s.; unwashed doubles, 17s. to 18s.; rough slack, 13s. 6d. to 14s. 6d. Yorkshire, Derbyshire, and Nottinghamshire—Screened steam coal, 19s. to 20s.; gas coke, 34s. per ton.

MIDLANDS.

The incoming of March has seen supply overtake demand in nearly every direction. Collieries which produce a large proportion of house coal made reductions of from 1s. to 3s. in the domestic grades; the amount varying according to the state of order books. The average for best coal is about 40s. at the pithead. Some special grades make up to 44s., and good qualities can be got round about 35s. Steams are plentiful at about 20s. D.S. nuts fetch 13s. to 15s., beans 12s. to 14s., slacks 7s. to 9s.

There is no lack of industrial fuel except in the case of the blast-furnaces. Hard cokes are still difficult to get, with the consequence that values are inclined to harden further. For contracts, 21s. to 22s. at ovens is named; but furnacemen are indisposed to buy forward on those terms except the pressure is great. Considerable quantities of coke are being bought for the pipe foundries, which have commitments that will not brook delay. The absorption for heating and miscellaneous services should be diminishing with the advance of the season; but there are no pronounced evidences of this as yet.

For prompt supplies, premiums of 4s. to 5s. on the contract basis are required. This means that pig iron costs more to make than it can be sold for; and, in view of the sluggish market position, some furnaces are being put on slack blast. Transport confusion is said to be aggravating the difficulties through which coke-using industries are passing.

Gas Affairs at Stockton.—At a recent meeting of the Stockton Town Council, Councillor T. Wilkinson, the Chairman of the Gas Committee, intimated that the Committee had been approached by the Synthetic Ammonia and Nitrates Company, with regard to taking gas in bulk from a low-temperature carbonization plant the Company contemplated installing at their Billingham Works. He hoped the Company's plans would materialize. A Sub-Committee had been appointed to negotiate with the Company. Councillor Wilkinson also drew attention to the Yarm and Haverton Hill gas undertakings. With regard to the Haverton Hill undertaking, for the six months ended Sept. 30 last, a profit of £11 was made, and that period included five months of the coal stoppage, during which the Stockton Works made a loss of £2355. Prior to this there was a profit of £1375 for the six months ended March, 1926, at Haverton Hill. At Yarm the profit in March, 1924, was £497; in 1925, £454; in 1926, £657; and for the six months ended Sept. 30 last, £203. The total profit on the undertaking since the Corporation took it over had therefore been £1812 from an outlay of £3000 capital. "I can say with confidence," concluded Councillor Wilkinson, "that the purchase of both these undertakings has been an unqualified success."

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

London, *March 7.*

There is little more inquiry for pitch, and it is reported that business is possible in the neighbourhood of 105s. to 110s. per ton in bulk at makers' works.

Creosote continues in demand at about 8¾d. to 9d. per gallon, and supplies are scarce.

Solvent naphtha is quiet at about 1s. 9d. per gallon for 95/160 quality.

Pure benzole is about 2s. 3d. per gallon, and pure toluole about 2s. 4d. to 2s. 5d. per gallon.

Phenol is unchanged at about 6d. per lb., in large drums and over-casks.

Tar Products in the Provinces.

March 7.

The average value for gas-works products during the week were: Gas-works tar, 71s. to 76s. Pitch, East Coast, 95s. to 100s. f.o.b. West Coast—Manchester, 92s. 6d. to 99s. 6d.; Liverpool, 95s. to 100s.; Clyde, 99s. 6d. to 100s. Benzole, 90 p.ct., North, 1s. 9d. to 1s. 10d.; crude, 65 p.ct. at 120° C., 1s. 2d. to 1s. 2½d., naked at makers' works; 50-90 p.ct. naked, North, 1s. 10d. to 1s. 11d. Toluole, naked, North, 1s. 8½d. to 1s. 9½d., nominal. Coal-tar crude naphtha, in bulk, North, 8½d. to 9d. Solvent naphtha, naked, North, 1s. 4½d. to 1s. 5½d. Heavy naphtha, North, 1s. 1d. to 1s. 2d. Creosote, in bulk, North, liquid, 7½d. to 7¾d.; salty, 7¼d. to 7½d.; Scotland, 7½d. to 7¾d. Heavy oils, in bulk, North, 9d. to 9¼d. Carbolic acid, 60 p.ct., 1s. 8½d. to 1s. 9½d. prompt. Naphthalene, £11 to £14; salts, 100s. to 110s., bags included. Anthracene, "A" quality, 2½d. per minimum 40 p.ct., purely nominal; "B" quality, unsaleable.

CONTRACTS OPEN.

Purifiers.

The City of Edinburgh are inviting estimates for the supply, delivery, and erection at the Granton Gas-Works of two sets of purifiers. [See advert. on p. 619.]

Condensers and Relining Saturator, &c.

The Gas Committee of the County Borough of Belfast are inviting tenders for the supply, delivery, and erection of three vertical water-cooled condensers and the relining of a saturator. [See advert. on p. 619.]

Twelve Butchers Suffer through Electricity.—At Keighley, on March 2, twelve local butchers were holding a meeting at the King's Arms Hotel. A dog in the room became violently sick, and shortly afterwards nine of the butchers passed into a state of unconsciousness. The trouble was caused by the escape into the room of fumes from the burning cover of a short-circuited electric cable under the pavement outside the hotel.

European Gas Company's Dividend.—The Directors of the European Gas Company, Ltd., have decided, subject to audit, to recommend the payment on the 1st of April next of a final dividend of 3s. per share free of income-tax, which, with the interim dividend paid on the 1st of October last, will represent a total dividend of 3 p.ct., free of income-tax, for the year ended Dec. 31, 1926. For the nine months, April-December, 1925, a dividend of 2 p.ct., free of income-tax, was paid.

Cardiff Gas Company's Athletic Club.—The sixth annual general meeting of the Cardiff Gas Company's Athletic and Social Club was held on March 4 at the Grand Hotel, Cardiff. The annual report showed that the club experienced a fairly successful year, both financially and otherwise. It has been extended, so that now four new sections have been inaugurated in the sports division. Efforts are being made to form a debating society. Following the meeting, a most successful smoking concert was held. Trophies and prizes were presented to the winners of inter-departmental tournaments and competitions. The H. D. Madden Cup was presented to Grangetown Station, who thus become the holders for the third successive year; the Directors' Challenge Cup and the Sullivan Cup to H. Williams, Grangetown; the George Clarry Cup to the Grangetown Manufacturing Department; and a new trophy, the Gains Cup, for the tug-of-war champions, to the Mains Department.

British Industries Fair.—The Heavy Section of the British Industries Fair, at Castle Bromwich, Birmingham, closed last Friday on the note upon which it opened—namely, that of optimism and confidence in the future of trade. It was certainly the most successful of the fairs held at Birmingham. During the eleven days of the Fair, visits were made by 50 trade delegations and over 2000 foreign buyers. On Friday night, as the stallholders drew the curtains over their stands for the last time, Mr. T. R. Martin, the Chairman of the Fair Management Committee, made the following official statement: "In regard to the amount of business done, it is extremely difficult to estimate this; and the wise exhibitor will not base his estimate too closely on orders actually placed. Results follow the exhibition, and very often the best results come months later. I am advised by our experts that the orders placed during the Fair may reasonably be estimated at round about £4,000,000, and the potential business is probably in the region of £18,000,000 to £20,000,000, spread over the next twelve months." Mr. Martin added that the most significant proof of the success of the Fair was probably to be found in the numbers of applications and inquiries received for space next year. Already 90 p.ct. of this year's exhibitors had notified their desire to have space again next year—in many cases to the extent of two or three times the amount they had been occupying.

Blackpool Gas Finances.—The Blackpool Gas Committee report a net balance profit on last year's working of £12,681, or £10,706 more than estimated. The price to ordinary and power consumers will be reduced by 2½d. per 1000 c.ft. from April 1, bringing the charge to almost a pre-strike figure. A net balance profit of £11,413 is estimated for next year.

Tribute to the Newport (Mon.) Gas Company.—Speaking at the annual dinner of the Newport (Mon.) Gas-Works Benefit Society, the Mayor (Mr. A. T. W. James) said: "I am thankful that the Gas Company is not a municipal undertaking. It creates a very healthy spirit of rivalry between the Electricity undertaking and the Gas Company; and that rivalry is to the benefit of the community. So long as there are two separate undertakings, there is no fear of the prices being raised to exorbitant and unfair figures." Mr. J. H. Canning, who presided, remarked that the unusual circumstances and the higher costs had resulted in an increase in the price of gas; but this would not continue for long. The prospects were quite bright and cheerful.

Gas at the Bradford Ideal Homes Exhibition.—The Bradford Corporation Gas Department have three attractive stands at an Ideal Homes Exhibition, opened on March 1, at the Belle Vue Drill Hall, Bradford, where household gas appliances are shown to excellent advantage and gas cookery is being specially emphasized by exhibition of apparatus and by twice-daily public demonstrations. All grades of gas cookers are being offered at the stand, as at the Department's showrooms in the city, on easy payment terms from 18s. per half-year upwards, with 20 ft. of piping fixed free of charge. The Electricity Department also have a stand at the same exhibition, and are featuring cookery in competition with the gas cooking. Public interest, however, is for the most part in the latter. Automatic control of the gas oven is being shown. The exhibition continues till March 12.

The Smokeless Coal Company, Ltd., has been registered as a private Company, with a nominal capital of £100 in £1 shares.

At Stourbridge the price of gas for power purposes only was reduced by 3d. per 1000 c.ft. from the end of the first half of the current quarter.

It was reported at the annual meeting of the Seaton (Devon) Gas and Coke Company that it had been decided to provide an independent supply for the adjoining village of Beer.

It is declared that the new increased railway charges for the transport of coal will cost the Halifax Corporation Gas Department an additional burden of £1200 in carriage of coal supplies.

The principal donations so far received to the Lord Mayor's fund for the relief of the families of the miners who lost their lives in the colliery disasters at Cwm and Bilsthorpe include one of £525 from the South Metropolitan Gas Company.

At the local Trades Exhibition, the Leamington Priors Gas Company have an excellent stand, on which they display all the latest appliances that can be utilized with gas; and the beneficial effects of this enterprise will doubtless be enhanced by the judicious advertising that accompanies it.

In connection with the proposed new gas-works at Conway, the Town Council have decided to lay a high-pressure gas main from the present gas-works, to improve the supply to Deganwy, and have instructed the Consulting Engineer (Mr. Newbigging) to prepare plans and details required by the Ministry of Health.

At a meeting of the Prestatyn Urban Council last week, Mr. G. O. Williams, in answer to a question as to the loss on the gas-works, said that, thanks to the excellent purchases of coal by the Gas Engineer and Mr. Caradoc Williams (Chairman of the Gas Committee), the loss on the undertaking had been greatly reduced, and the concern was flourishing.

The Royal Humane Society's bronze medal has been awarded to Mr. John Dodge, of Lower Edmonton, an erector in the employ of Messrs. Clayton, Son, & Co., contractors, Hunslet, Leeds, for saving the life of a fellow-workman at the Mitcham Gas-Works. He jumped into a gasholder tank in which there was tar and ammoniacal liquor to the depth of 20 ft. and saved a comrade who had fallen in.

In response to a petition presented to the Plymouth Corporation Gas Committee by residents in the neighbourhood of Ker Street, Devonport, the Engineer and Manager of the Corporation Gas-Works at Devonport has intimated that the inadequate supply of gas has been the subject of consideration by the Committee for some time, and that it has now been decided to provide a new trunk main to supply the district, at a cost of £16,364.

The Belfast Gas Committee applied to the Ulster Labour Ministry for an Unemployment Relief Grant towards the cost of reconstructing and remodelling the existing bench of vertical retorts, together with the installation of waste-heat boilers at the gas-works. A reply was received stating that the Minister very much appreciated the attitude of the Corporation in desiring to provide additional employment by carrying out this work; but in view of the fact that the work would in any event have to be undertaken during the next two years, in order to enable the plant to meet normal requirements, the scheme could not be regarded as satisfying the conditions. Accordingly, it would be impossible to sanction the payment of a relief grant.

Lecturing before the members of the science section of the Plymouth Athenæum, on Friday, March 4, on the romance of coal tar, Mr. T. T. Barnes remarked that, when Murdoch first used coal gas for illumination purposes near Redruth, in 1780, people travelled miles in order to see the wonder of a wickless flame. The distillation of tar began about 1850; and six years later Perkin discovered the first of the aniline dyes. In 1869 he synthesized alizarine from anthracene, which soon became so cheap that the madder-growing industry in France was destroyed. Mr. Barnes proceeded to describe the types of dyes derived from tar, and how they were prepared; and he also dealt with the preparation of intermediates for the production of drugs, flavouring essences, and explosives.

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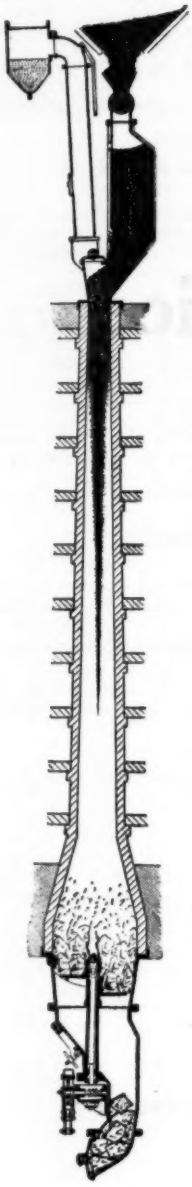

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STOCK MARKET REPORT.

THE "Account" came to a quiet conclusion on the Exchange last week; and with Chinese affairs less menacing, the markets were steadier. Gilt-edged stocks developed strength; a feature being the recovery in the new 4 p.ct. Consolidation Loan. The two new Corporation loans—Bristol and Ayr—rather contrary to expectation a week ago, were completely successful, both lists being closed before the advertised date.

The improvement in Home Rails continued, and presented quite a robust appearance, there being many buyers for permanent holding.

The Gas Market was quite satisfactory from the investor's point of view. Although there was no striking improvement in values, transactions were frequently made at the highest quotations. Bristol 5 p.ct. maximum was marked up 1 point and Newcastle 1½ points at the local Exchanges. On the other hand, South Shields consolidated suffered a rather unusual drop of 5 points in the *ex* div. price. There was a particularly large number of inquiries for the Commercial stocks; and there are standng orders for stocks of the outlying London companies. The dividend announcements of the week include Brighton original 12 p.ct. per annum and "A" ordinary 9 p.ct. per annum, Lea Bridge 6¼ p.ct. per annum, and Tynemouth consolidated and new 5 p.ct. per annum. All these are at the same rates as for the corresponding period of 1925. The European Company have recommended a final dividend of 3s. per share (free of income-tax), making 3 p.ct. (free of income-tax) for the year, as compared with 5 p.ct. for the year to March, 1925.

Issue.	Share.	When ex-Dividend.	Dividends. Prev. Hf.Yr	Dividends. Last Hf. Yr.	NAME.	Quotations. Mar. 4.	Rise or Fall on Week.	Transactions. Lowest and Highest Prices.
£			%p.n.	% p.n.				
171,978	Stk.	Feb. 10	5	5	Aldershot 5 p.c. max. C.	70—78	..	..
222,992	,,	,,	4	4	Do. 4 p.c. Pref.	63—71	..	69—69
1,551,868	,,	Sept. 30	6½	6½	Alliance & Dublin Ord.	81—86	..	84½
374,000	,,	Jan. 13	4	4	Do. 4 p.c. Deb.	65—68	..	..
300.000	1	Oct. 14	1/7½	1/7½	Bombay, Ltd.	1—1½	..	..
170 000	10	Aug. 26	8½	8½	Bournemouth 5 p.c.	12½—13½	+½	13½
600,050	10	,,	7	7	Do. B 7 p.c.	12—13	..	12½
275,000	10	,,	6	6	Do. Pref. 6 p.c.	11—12	..	..
50.000	Stk.	Jan. 13	3	3	Do. 3 p.c. Deb.	63—66	..	..
163,025	,,	,,	4	4	Do. 4 p.c. Deb.	73—76	..	..
214,740	,,	Aug. 26	12	12	Brighton & Hove Orig.	168—168	..	..
244,200	,,	,,	9	9	Do A Ord.	125—130	..	..
1,387,500	,,	Feb. 24	6	5	Bristol 5 p.c. max.	85a—86½a*	+1	..
865,000	,,	Sept. 30	7	8	British Ord.	107—110	..	109—110
100,000	,,	Dec. 30	7	7	Do. 7 p.c. Pref.	112—117	..	..
120.000	,,	,,	4	4	Do. 4 p.c. Red. Deb.	75—80	..	..
100,000	10	Dec. 9	8	6	Cape Town, Ltd.	7—8	..	..
100,000	10	Oct. 28	4½	4½	Do. 4½ p.c. Pref.	6—7	..	..
150,000	Stk.	Dec. 30	4½	4½	Do. 4½ p.c. Deb.	68—73	..	..
626,860	,,	Feb. 24	6	6	Cardiff Con. Ord.	95—98*	..	..
237,860	,,	Dec. 30	7½	7½	Do. 7½ p.c. Red. Deb.	100—103	..	..
157,150	,,	Feb 24	5	6½	Chester 5 p.c. Ord.	86½—91½b*	..	..
79.185	1	Sept. 30	†2/-	†2/-	Colombo Ltd. Ord.	27/—29/-	..	..
24.495	1	,,	1/4‡	1/4‡	Do. 7 p.c. Pref.	30/—32/-	..	..
321,490	1	Oct. 14	1/9‡	1/7½	Colonial Gas Assn. Ld. Ord.	25/—27/-	..	25/10½—26/3
173,900	1	,,	1/9‡	1/7½	Do. 8 p.c. Pref.	21/—23/-	..	21/6 - 22/-
1,618,280	Stk.	Feb. 2	5½	6½	Commercial 4 p.c. Cap.	82—85*	..	83—83½
650,000	,,	,,	5/3/4	5/3/4	Do. 3½ p.c. Cap.	80—83*	..	82—83
475,000	,,	Dec. 30	3	3	Do 3 p.c. Deb.	54—57	..	..
600.000	,,	Sept. 30	§2	§1	Continental Union, Ltd.	28—33	..	29½ - 30
300.000	,,	,,	7	7	Do. 7 p.c. Pref.	82—86	..	..
787,560	,,	Aug. 12	6½	6½	Croydon sliding scale	96—99	..	..
409,100	,,	,,	5	5	Do. max. div.	78—81	..	80½—81½
492,270	,,	Feb. 24	8	9	Derby Con.	106—108c*	..	..
55,000	,,	Dec. 30	4	4	Do. Deb.	73—75c	..	..
309,000	,,	Sept. 16	5	5	East Hull Ord. 5 p.c.	78—82	..	..
50,000	,,	Dec. 30	5	5	Eastbourne 5 p.c. Deb.	90 95	..	..
1,002,180	10	Sept. 30	†4	†3	European, Ltd.	6—7	..	6½—6¾
18,747,460	Stk.	Feb. 10	5/1/4	5	Gas Light & Coke 4 p.c. Ord.	86½—88½	..	87½—88½
2,600,000	,,	,,	3½	3½	Do. 3½ p.c. max.	58—61	..	59½—60½
4,167,020	,,	,,	4	4	Do. 4 p.c. Con. Pref.	74—77	..	76—77
5,602,820	,,	Dec. 30	3	3	Do. 3 p.c. Con. Deb.	58—61	..	59½—60½
181,315	,,	,,	—	6	Do. 6 p.c. Br'tf'd Rd. Db.	100 105	..	..
1,642,770	,,	,,	—	5	Do. 5 p.c. Red. Deb.	99—100	..	99½½—100
42.000	,,	,,	7½	7½	Do. 7½ p.c. Ilford Deb.	..	..	..
82,500	,,	Aug. 26	6½	6½	Hastings & St L. 5 p.c. Conv	87—92	..	..
358,740	,,	,,	5½	6½	Do. 8½ p.c. Conv.	66—71	..	..
70.000	10	Oct. 14	†10	†10	Hongkong & China, Ltd.	12 18	..	12½
173,200	Stk.	Sept. 16	5	5	Hornsey Con. 3½ p.c.	69—71	..	..
1,976,000	,,	Nov. 11	‡10	10	Imperial Continental Cap.	133—136	..	134—135½
226,170	,,	Feb. 10	3½	3½	Do. 3½ p.c. Red. Deb.	67—19	..	..
235,242	,,	Aug. 12	6½	6½	Lea Bridge 5 p.c. Ord.	94—99	..	95½
2,145,907	,,	Feb. 24	5½	6½	Liverpool 5 p.c. Ord.	80 81½*	..	80½—80½
600 000	,,	Sept. 30	7	7	Do. 7 p.c. Red. Pref.	104—106b	..	104½
165,736	,,	Feb. 24	9	8	Maidstone 5 p.c. Cap.	110—115*	..	..
68.480	,,	Dec. 30	3	3	Do. 3 p.c. Deb.	52—57	..	..
75,000	5	Dec. 9	†7	†7	Malta & Mediterranean	5½—6½	..	..
541,920	Stk.	Nov. 25	†6	†5	Montevideo, Ltd.	80 85	..	81½—82½
2,061,815	,,	Feb. 24	5	5	Newcastle & Gateshead Con.	71—72d*	+1½	..
360.929	,,	,,	4	4	Do. 4 p.c. Pref.	68½—69½d*	..	..
691,705	,,	Dec. 30	3½	3½	Do. 3½ p.c. Deb.	67½—67½d	..	..
15,000	,,	Aug. 26	11½	11½	North Middlesex 10 p.c.	155—160	..	..
91,530	,,	,,	8½b	8½b	Do. 7 p.c.	109—114	..	..
300,000	,,	Nov. 25	7	9	Oriental, Ltd.	97—102	..	101—102
188,120	,,	Dec. 30	7½	7½	Plym'th & Stonehouse 5 p.c.	105—110	..	..
414,500	,,	Feb. 24	7½	7½	Portsm'th Con. Stk. 4p.c Std.	100—105*	..	..
285,732	,,	,,	5	5	Do. 5 p.c. max.	76 79*	..	..
2,389,809	1	—	—	—	Primitiva Ord.	14/—15/-	..	14/8—14/7½
282,200	100	Dec. 1	4	4	Do. 4 p.c. Red. Deb.	85—87	+1	85—86
600,000	Stk.	Jan. 27	4	4	Do. 4 p.c. Red. Deb. 1911	69—71	..	..
434 968	,,	Dec. 30	—	4	Do. 4 p.c. Cons. Deb.	69—71	..	70—71
150,000	10	Sept. 30	6	6	San Paulo 6 p.c. Pref.	7½—8	..	..
125,000	50	July 1	5	5	Do. 5 p.c. Red. Deb.	47—50	..	..
270.000	Stk.	Sept. 16	6	5½	Sheffield A	96—98s	..	..
419,968	,,	,,	6	5½	Do. B	96—98s	..	..
1,047 000	,,	,,	6	5½	Do. C	96—98s	..	..
90.000	10	June 11	4	—	South African	4—6	..	88/9
6,609,895	Stk.	Feb. 24	5	7	South Met. Ord.	96—98*	..	96½—99½
1,895,445	,,	Jan. 13	3	3	Do. 3 p.c. Deb.	57—60	..	59
734.000	,,	Sept. 16	6½	6½	Do. 6½ p.c. Red. Db.	101—103	..	102
91.500	,,	Feb. 24	8½	8½	South Shields Con.	108—110d*	−5	..
1,243,795	,,	Aug. 12	6½	6½	South Suburban Ord. 5 p.c.	102—105	..	103½—105
368,817	,,	Dec. 30	5	5	Do. 5 p.c. Deb.	93 96	..	94½
647,740	,,	Oct. 14	5	5	South'mpton Ord. 5 p.c. max.	76—79	..	..
121,275	,,	Dec. 30	4	4	Do. 4 p.c. Deb.	68 78	..	..
250.000	,,	Feb 24	7	7	Swansea 7 p.c. Red. Pref.	100—102*	..	..
300,000	,,	Dec. 30	6½	6½	Do. 6½ p.c. Red. Deb.	102—104	..	..
120,000	,,	Feb. 24	7½	7½	Tottenham District A 5 p.c.	105—110*	..	..
882,275	,,	,,	6½	6½	Do. B 3½ p.c.	89—92*	..	90½—91
150,000	,,	,,	5½	5½	Do. 5½ p.c. Pref.	97—100*	..	..
181,255	,,	Dec. 9	4	4	Do. 4 p.c. Deb.	72—75	..	..
258,251	,,	Aug. 26	5	5	Tynemouth Con. and New	69½—70½d	..	..
197,294	,,	Aug. 26	6¾	6½	Uxbridge, Maidenhead, & Wycombe 5 p.c.	87—92	..	..
88,330	,,	,,	5	5	Do. 5 p.c. pref.	88—88	..	..
91,800	,,	,,	6¾	6½	Do. 5 p.c. Maidenh'd	85—90	..	..
80.000	,,	July 8	8½	8½	Wandsworth, Wimbledon, and Epsom— Wandsworth A 5 p.c.	122—127	..	..
255,836	,,	,,	7	7	Do. B 3½ p.c.	102—107	..	102½—103½
434,735	,,	,,	5/19/0	5/19/0	Do. C and New	88—93	..	..
352,000	,,	,,	6¾	6¾	Wimbledon 5 p.c.	98—103	..	..
98,000	,,	,,	7½	7½	Epsom 5 p.c.	104—109	..	..
88,416	,,	Dec. 30	3	3	3 p.c. Deb.	54—57	..	..

Quotations at:—a.—Bristol. b.—Liverpool. c.—Nottingham. d.—Newcastle. s.—Sheffield. *Ex. div. † Paid free of income-tax. ‡ Plus 8½ p.ct. p.a. special dividend. § For year.

The Bank Rate is 5 p.ct., to which it was raised from 4 p.ct. on Dec. 3, 1925. Bankers' deposit rates are 3 p.ct. The deposit rates of the discount houses are 3 p.ct. at call and 3½ p.ct. at notice.

The following transactions were recorded during the week:

On Monday, Commercial 4 p.ct. 83, European 6⅞, Gas Light and Coke, 87⅛, 87⅜, 88, 3½ p.ct. 59½, 59⅝, 60½, 3 p.ct. debenture 60½, 5 p.ct. debenture 99⅛⅛, Imperial Continental 134, 135½, Montevideo. 81⅛, Primitiva 14s. 7½d., South Metropolitan 96½, 97½, 97½, 3 p.ct. debenture 59, Tottenham "B" 90¼, 90½, Wandsworth "B" 102⅝, 103, 103¼. Supplementary prices, British Norwich 3 p.ct. debentures 54½, Colonial 8½ p.ct. debentures 101½, Liverpool 5 p.ct. 80⅛.

On Tuesday, Aldershot 4 p.ct. preference 68, Bournemouth 5 p.ct. 13¼, Commercial 3½ p.ct. 82, 83, Continental Union 30, Croydon maximum 81, European 6⅛⅛, Gas Light and Coke 87½, 87⅜, 88¼, 3½ p.ct. 59⅜, 4 p.ct. preference 76½. 5 p.ct. debenture 100, Imperial Continental 135½, Lea Bridge 5 p.ct. 95½. Montevideo 81⅜, 82½, 82⅛, Oriental 101, 102, Primitiva 14s. 3d., 14s. 4½d., 4 p.ct. consolidated debenture 70, 70½, South Metropolitan 97¼, 97⅜, 99½, 6½ p.ct. debenture 102, Tuscan 20s. Supplementary prices, Bournemouth 7 p.ct. debenture 102½, British Norwich 3 p.ct. debenture 54, Sutton 105, 105½.

On Wednesday, Commercial 4 p.ct. 83, 83⅜, 3½ p.ct. 82½, 83, Croydon maximum dividend 80½, 81½, Euronean 6½, Gas Light and Coke 87½, 87⅝ 87⅜, 88, 88¼, 4 p.ct. preference 76½, 3 p.ct. debenture 60½, Hong Kong and China 12½, Imperial Continental 134½, 135½, Primitiva 14s. 4½d., 14s. 6d., 14s. 7½d., 4 p.ct. 1st debenture 85, 86, 4 p.ct. debenture 70½, 71, South African 88s. 9d., South Metropolitan 96⅞, South Suburban 5 p.ct. 103½, Tottenham "B" 90½, 91. Supplementary prices, Bournemouth 7 p.ct. debenture 103¼, British Hull 5 p.ct. debenture 96, Danish 8⅛.

On Thursday, Colonial 26s. 3d., Continental Union 30, Euronean 6½, Gas Light and Coke 87½, 87⅝, 87⅜, 88, 88¼, 4 p.ct. preference 76, 76½, 3 p.ct. debenture 59⅝, 59⅞, 60, 5 p.ct. debenture 99⅛⅛, Imperial Continental 134½, 135½, Montevideo 82, 82½, Primitiva 14s. 4½d., 14s. 6d., 4 p.ct. 1st debentures 85½, South Metropolitan 96½, 97, 3 p.ct. debenture 59, South Suburban 104, 104⅛, 5 p.ct. debenture 04¼. Supplementary prices, Liverpool 5 p.ct. 80⅛.

On Friday, Aldershot 4 p.ct. preference 68, 69, Alliance and Dublin 84½, Bournemouth "B" 12⅛, British 109, 110, Colonial 25s. 10½d., 26s. 3d., 8 p.ct. preference 21s. 6d., 22s., Commercial 4 p.ct. 83¼, Continental Union 29½, Gas Light and Coke 87⅜, 88, 88¼, 4 p.ct. preference 77, 5 p.ct. debenture 00⅛⅛, Imperial Continental 135, 135½, Primitiva 14s. 3d., 14s. 4½d., 14s. 5½d., 14s. 7½d., South Metropolitan 97¼, 98, South Suburban 104, 104⅞, 105 Tottenham 3½ p.ct. 90½, 91. Supplementary prices, Ascot 10 p.ct. 10. Barnet "A" 130, "B" 130, "D" 100, Redhill 5 p.ct. debenture 96½, Wandsworth 3½ p.ct. new 88½.

The large payment of Railway dividends had little effect on the conditions in Lombard Street last week, at the close of which a lessening of the demand brought about a reduction in the accommodation rates. Old day-to-day loans were renewed at 4 p.ct., but new loans were secured at as low as 3½ p.ct. A reaction occurred in the rate at which the Treasury Bill allotments were made, there being a fall of nearly 2s. p.ct. to £4 7s. 5·61d. p.ct. As was inevitable, discount rates were easier.

The Foreign Exchange Market was active. Paris again offered dollars, and the New York rate rose to 4.85 5/16, but reacted to 4.85 3/16. The Paris rate was steady at 124.10½. Italian lire dropped slightly to 110½, and Belgas were unchanged.

Silver on Indian support was firmer at 25⅜d. per oz.; and the price of Gold was lowered 1d. to 84s. 10½d. per oz.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer—not necessarily for publication, but as a proof of good faith.

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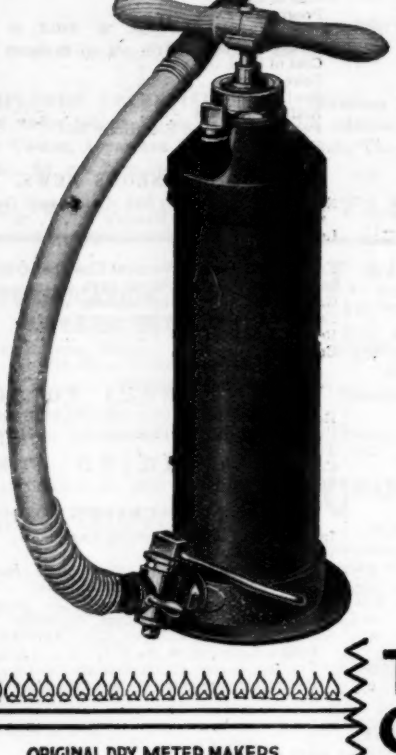

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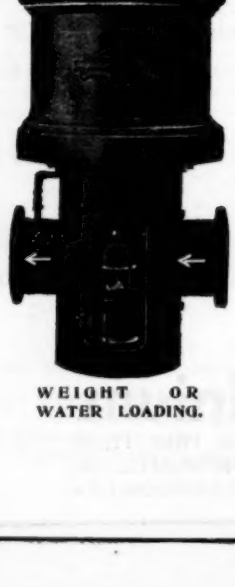

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